

Impervious Surfaces

Maryland

1985 - 2010

USGS

What:

We received impervious surface data for the years 1985 – 2010 from the U.S. Geological Survey via the Chesapeake Bay Program (within USGS). The data are 6” raster imagery files.

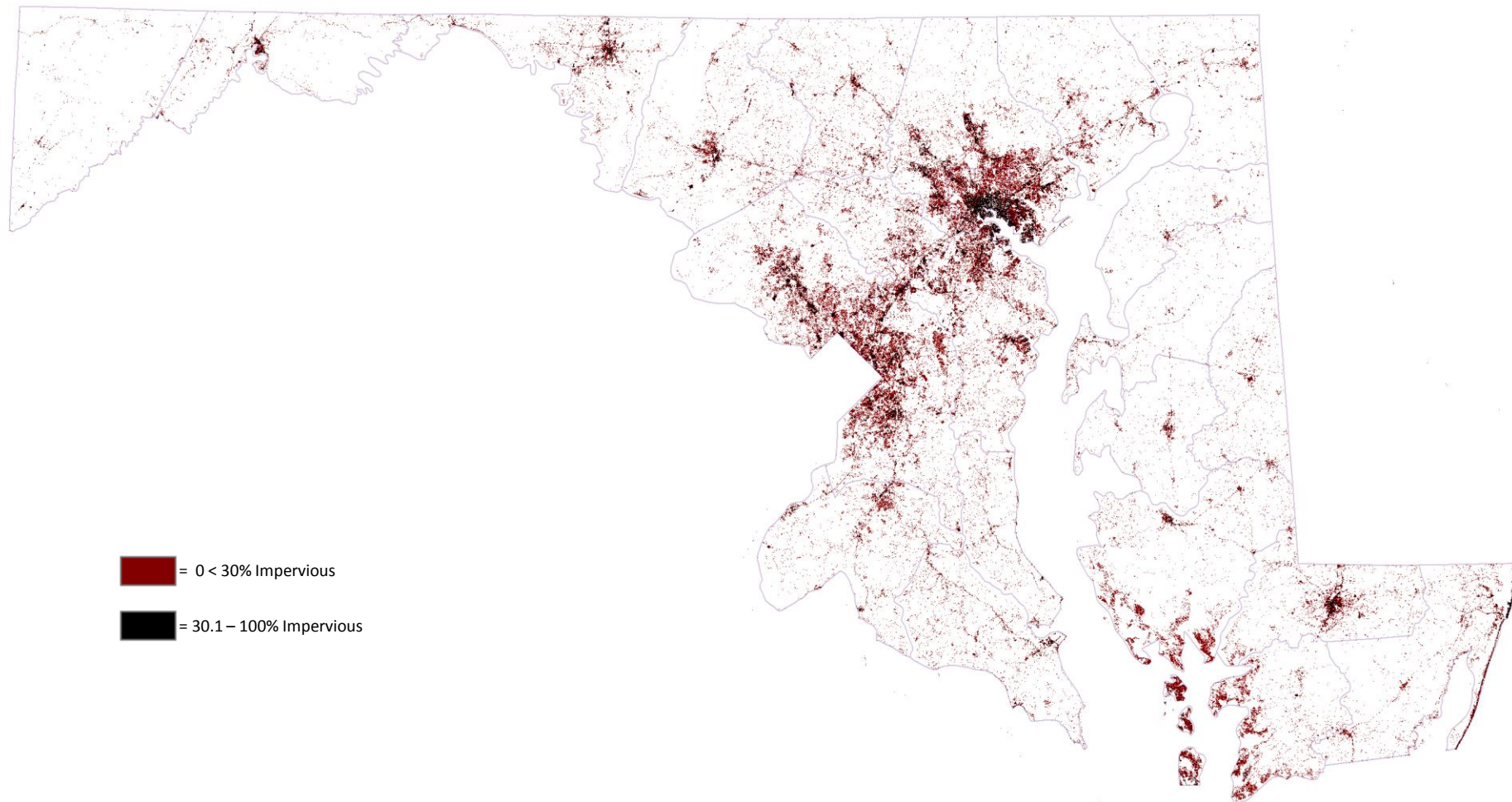
What We Did:

We performed 2 analyses:

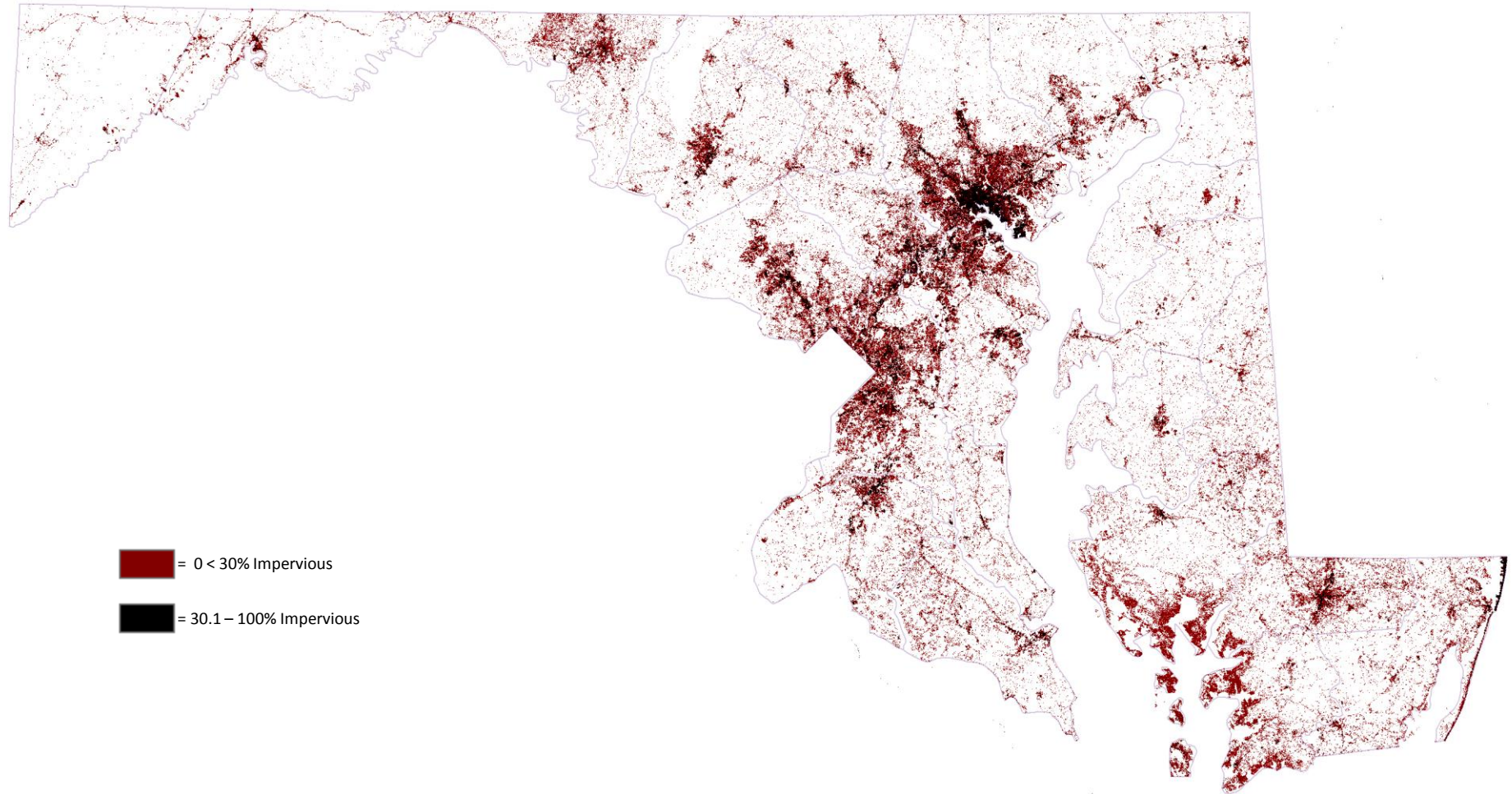
1. Reclassified the raster files based on the percent impervious attribute provided in the data for clearer visualization
2. Converted the raster files to polygons and intersected these with MDP’s Land Use Land Cover (LULC) polygon in order to ascertain whether our LULC was aligned with the aerial imagery obtained. This intersection gave us the percentage-impervious of all of the Land Uses notated in MDP’s LULC feature class.

Impervious Surfaces > Raster Analyses

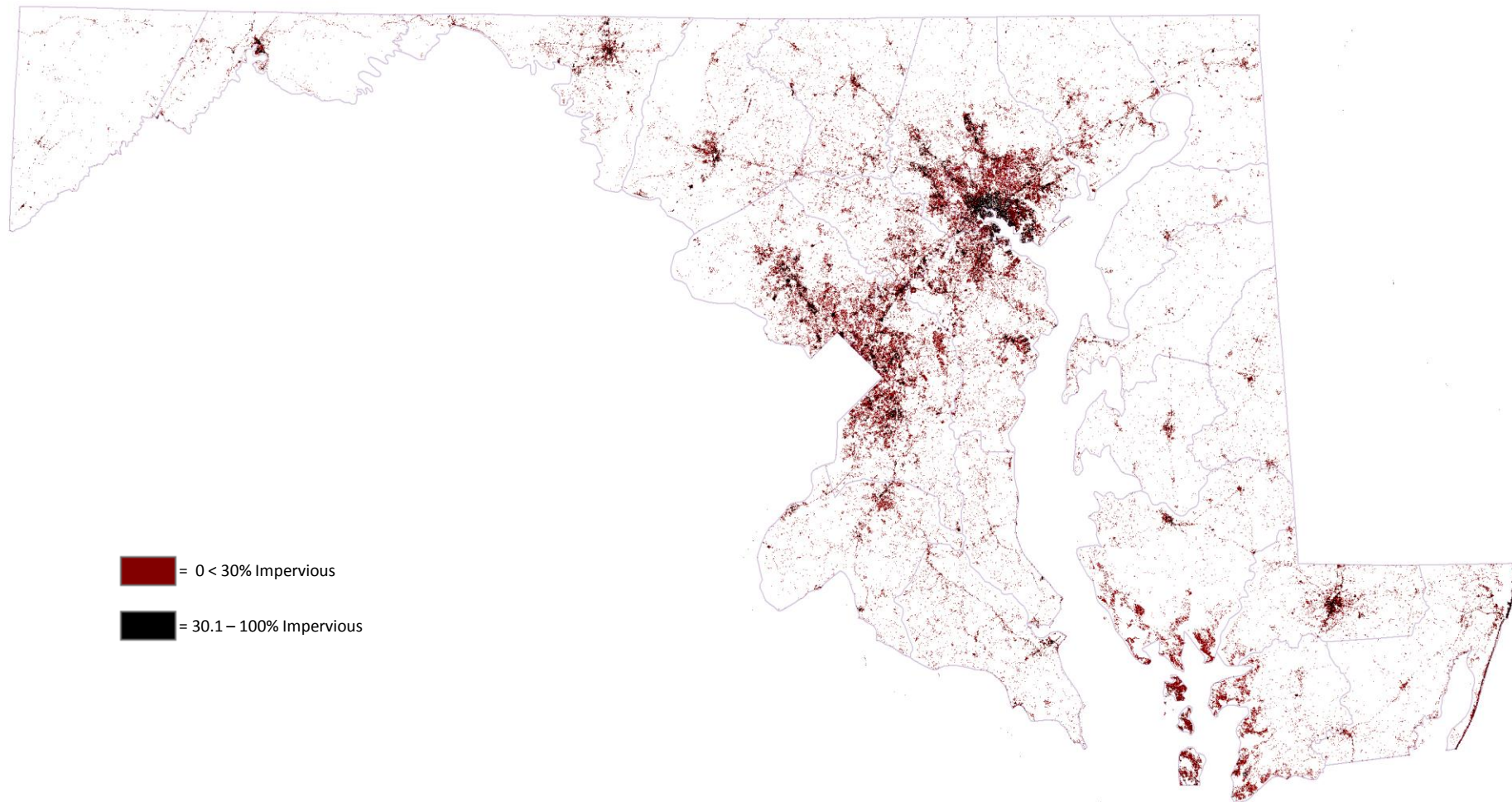
1985



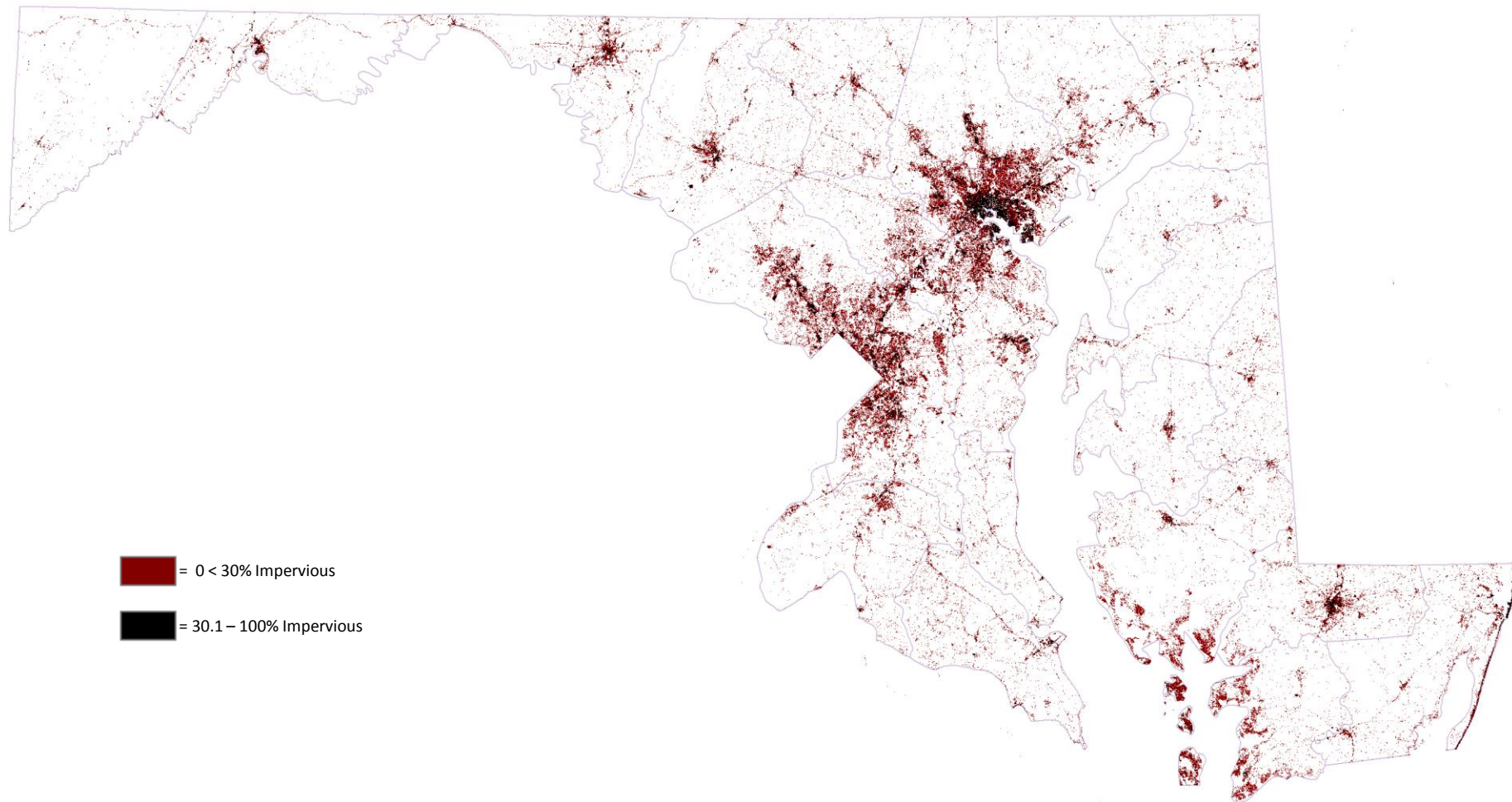
2010



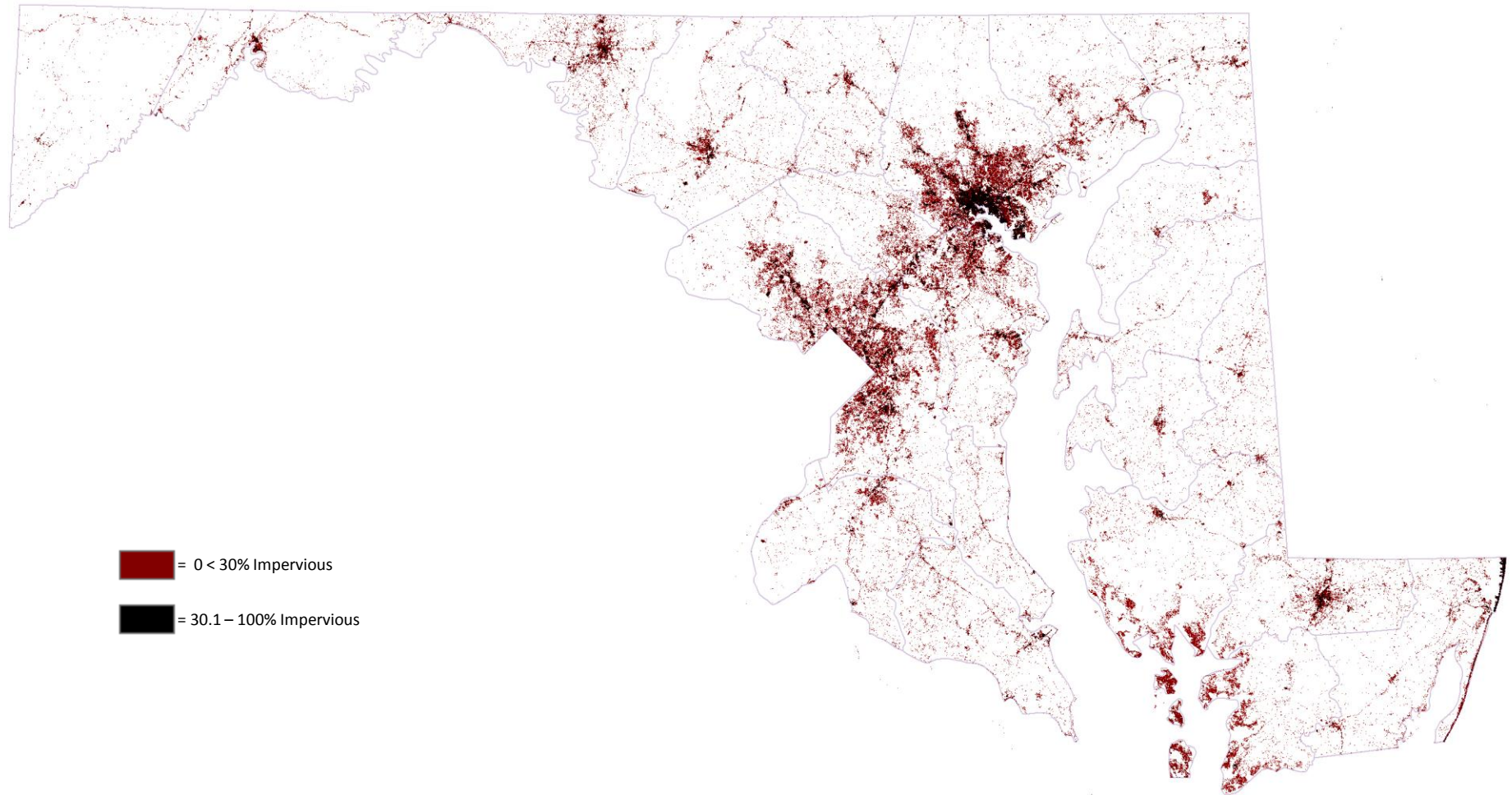
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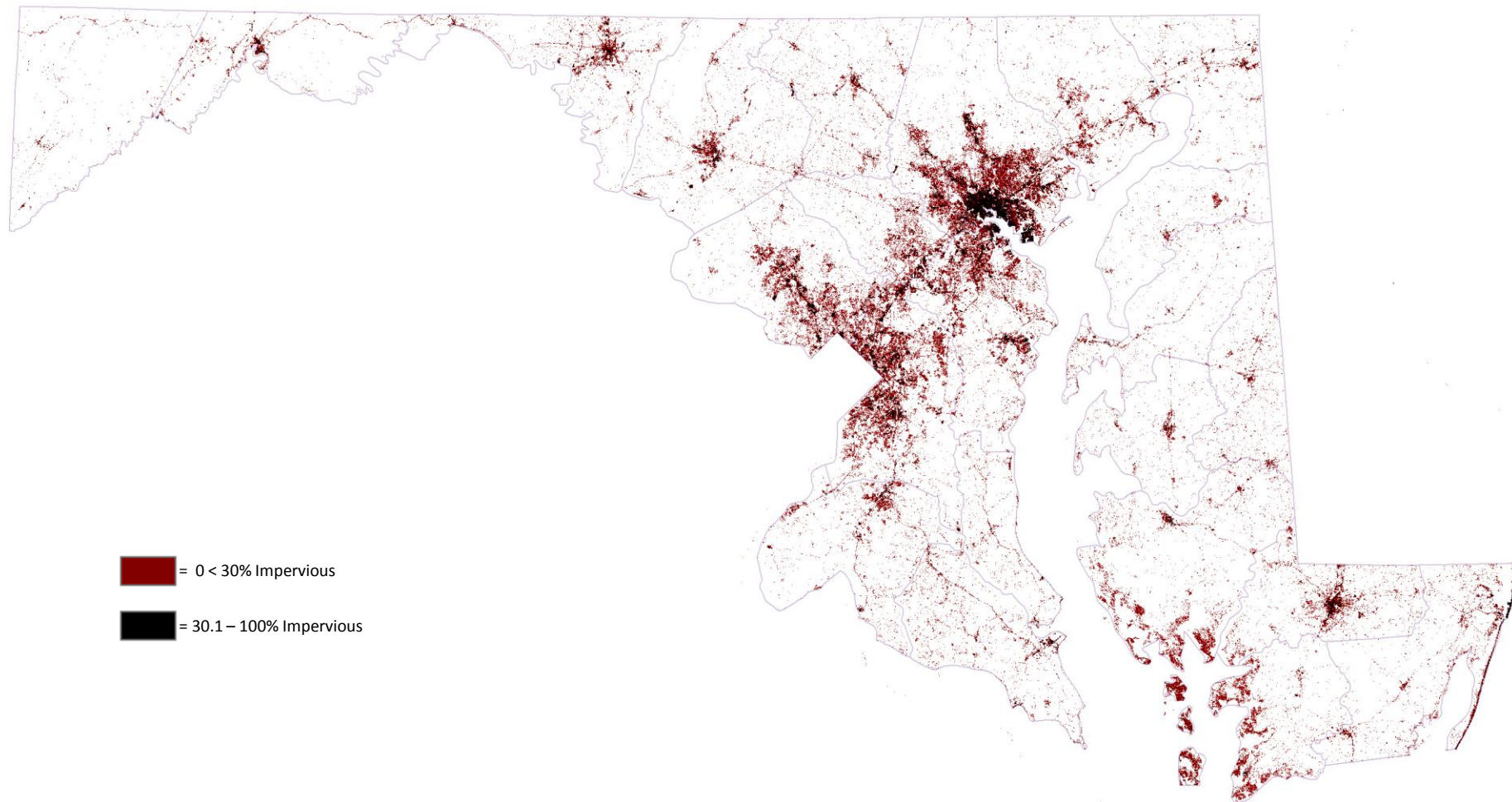
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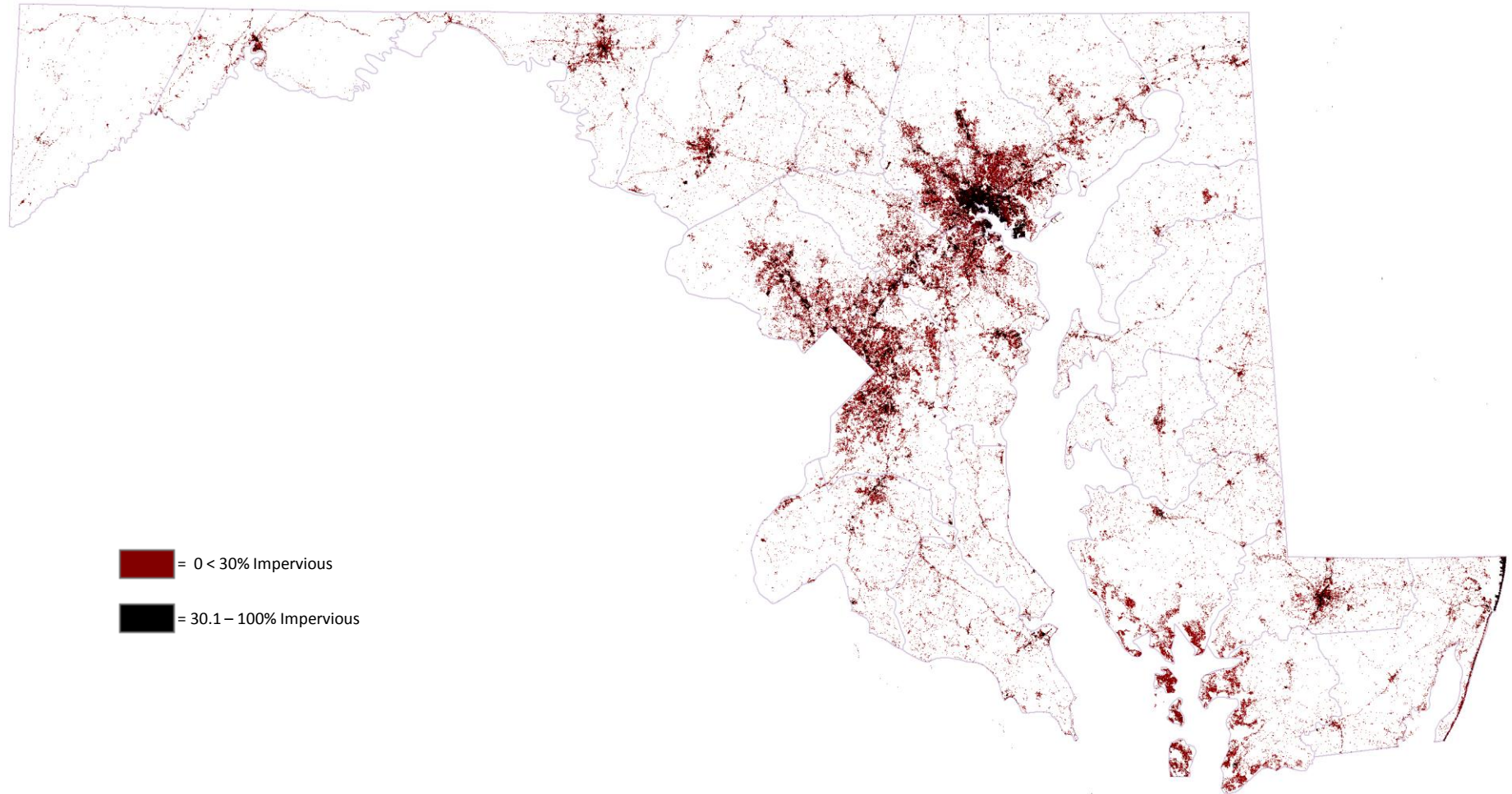
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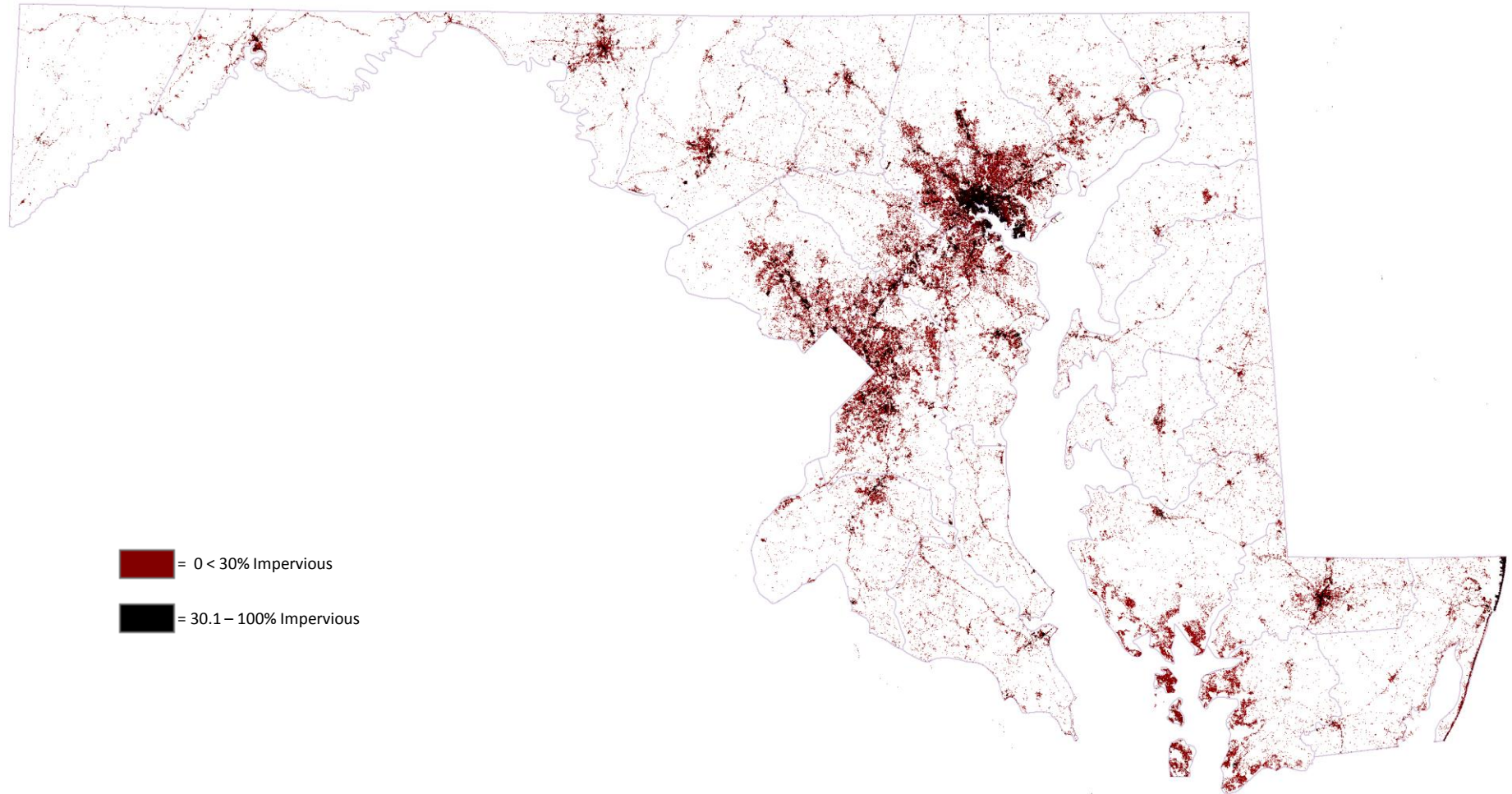
1988



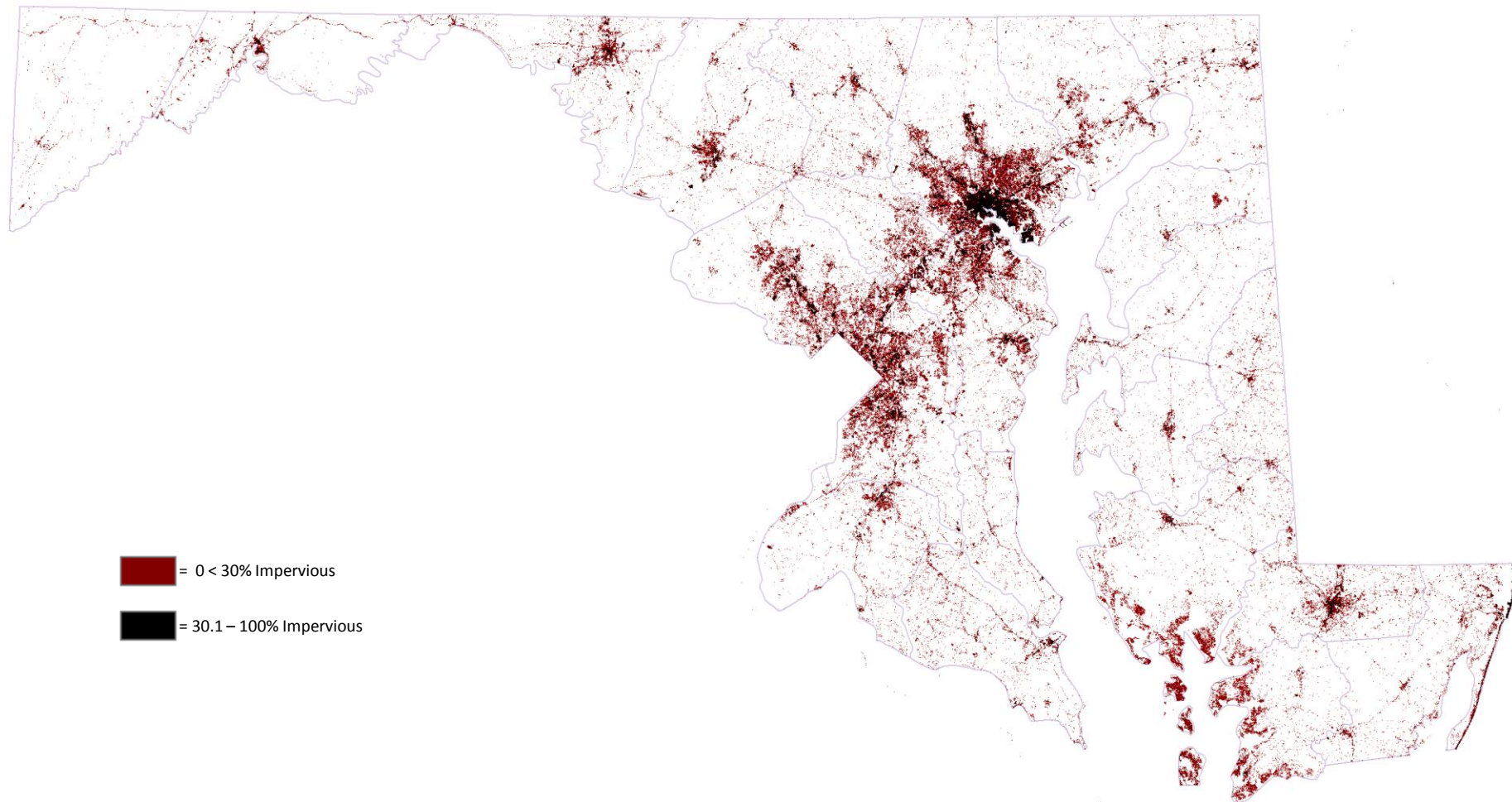
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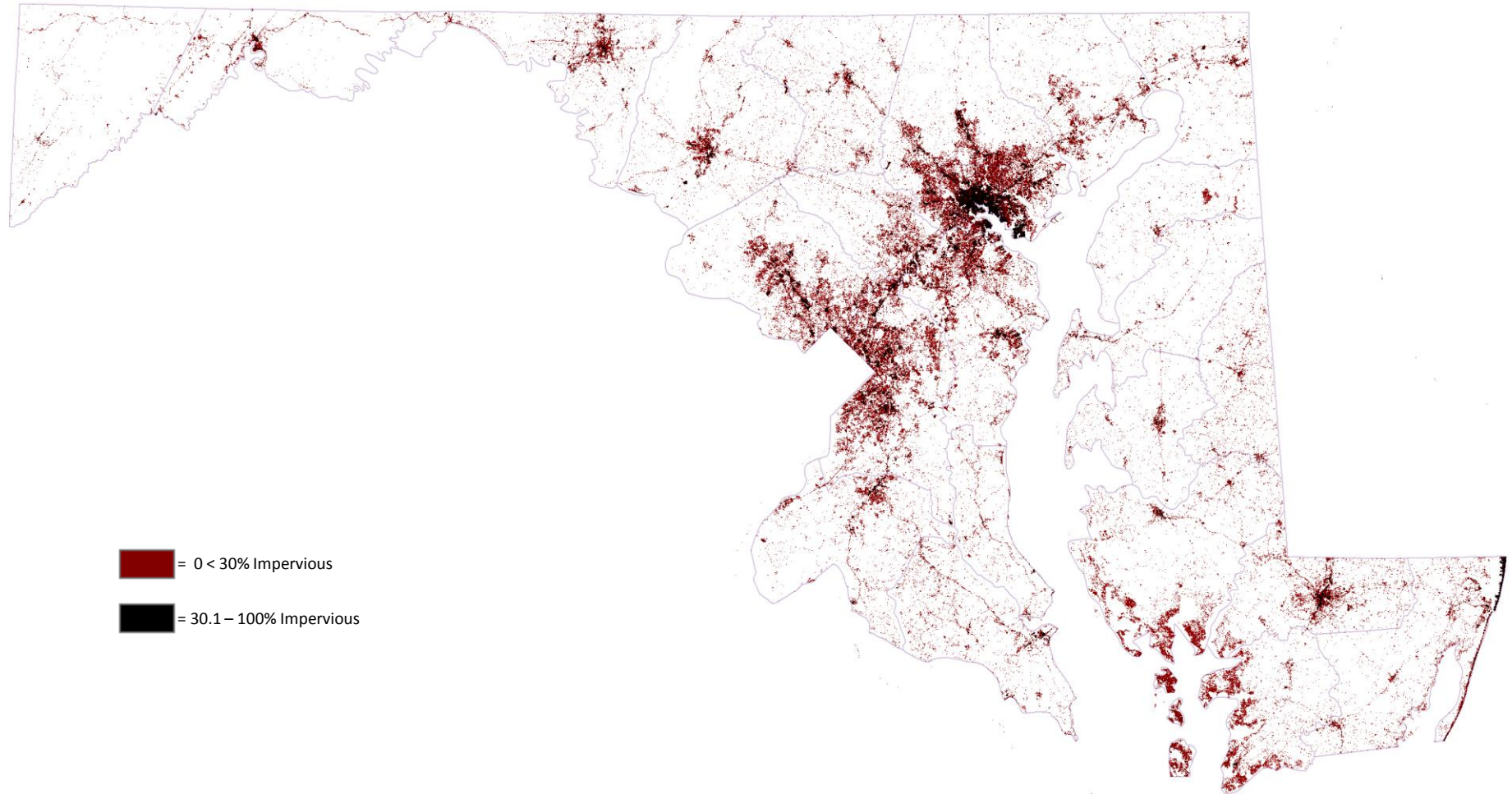
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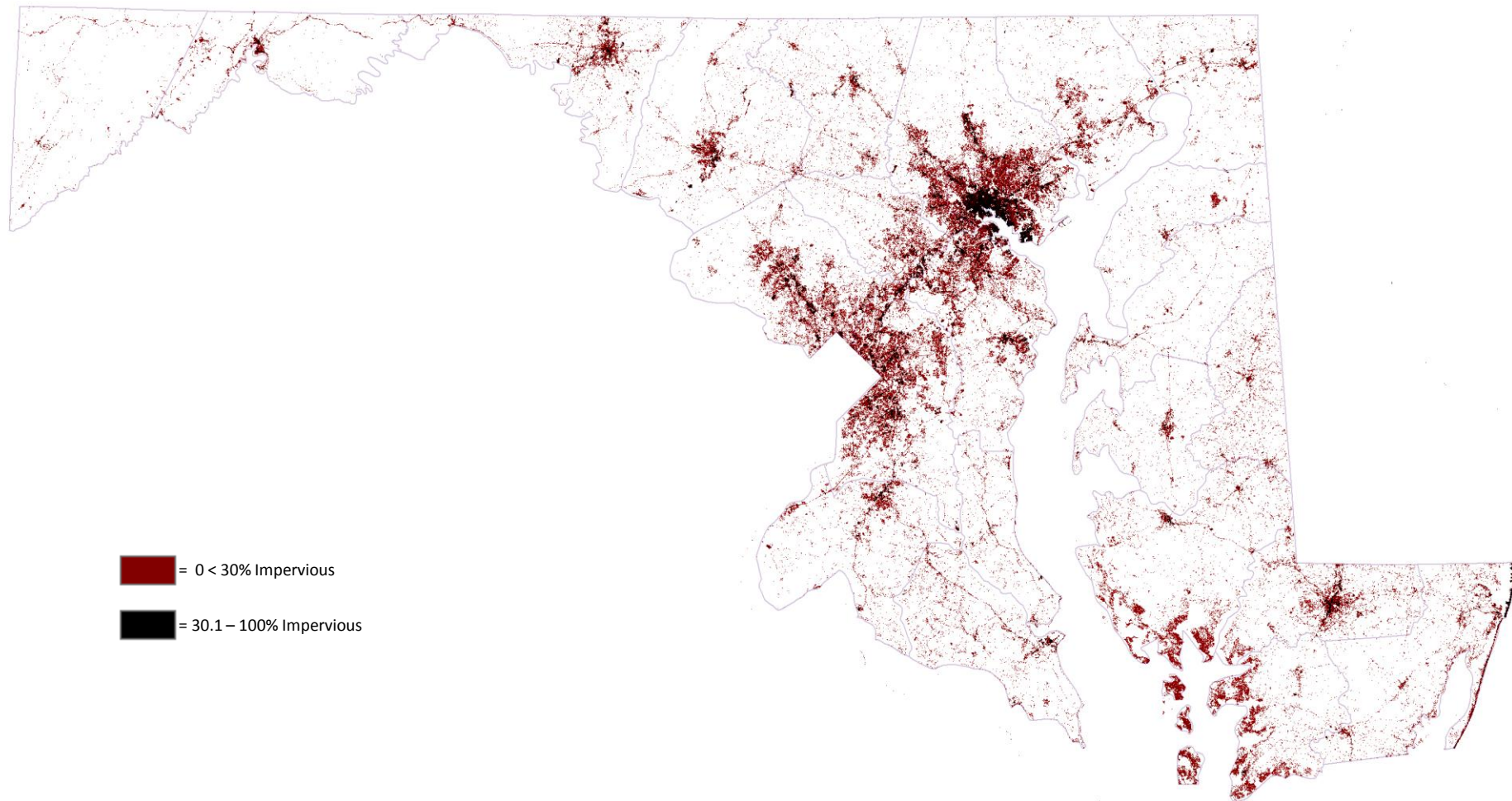
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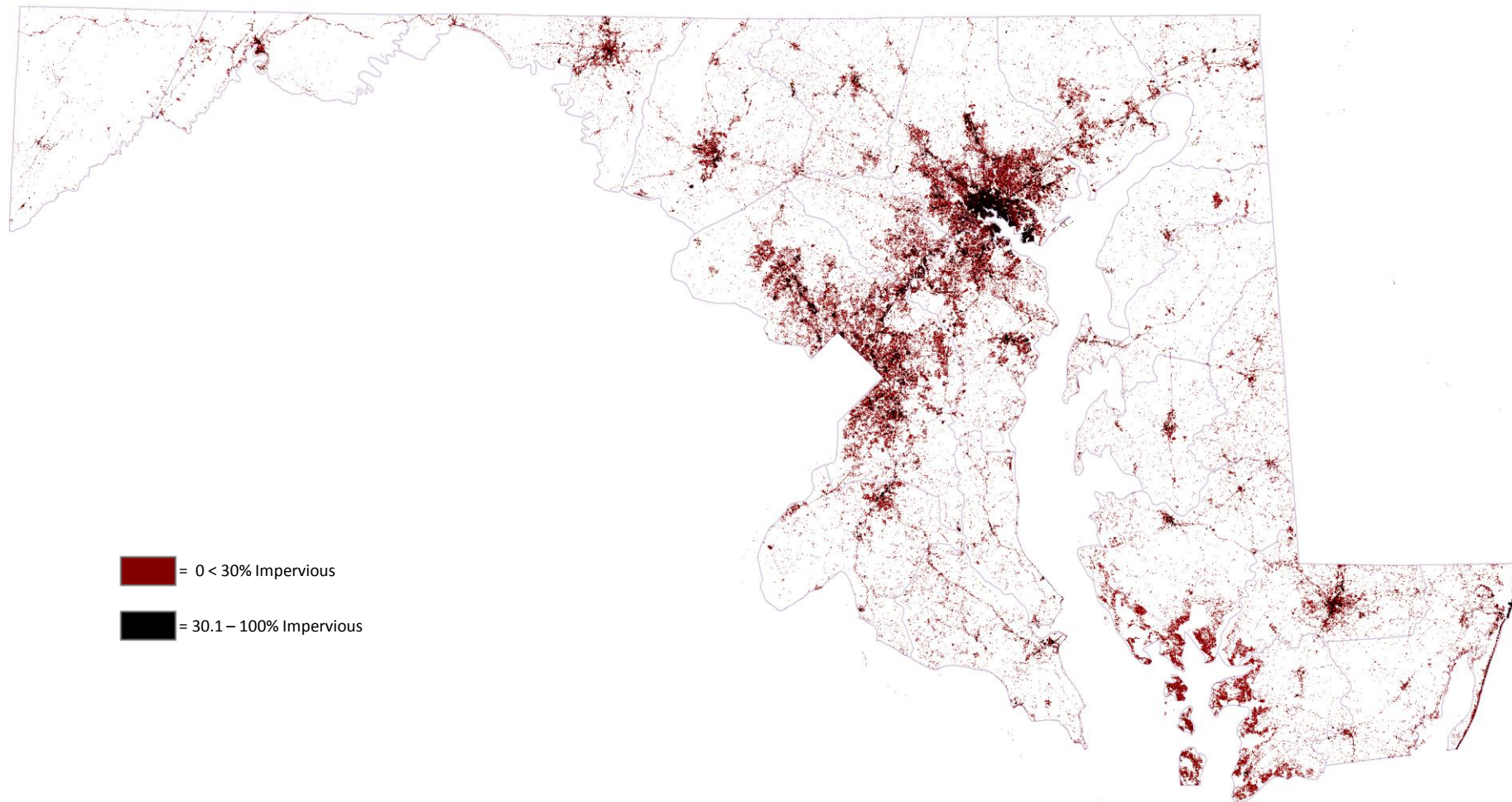
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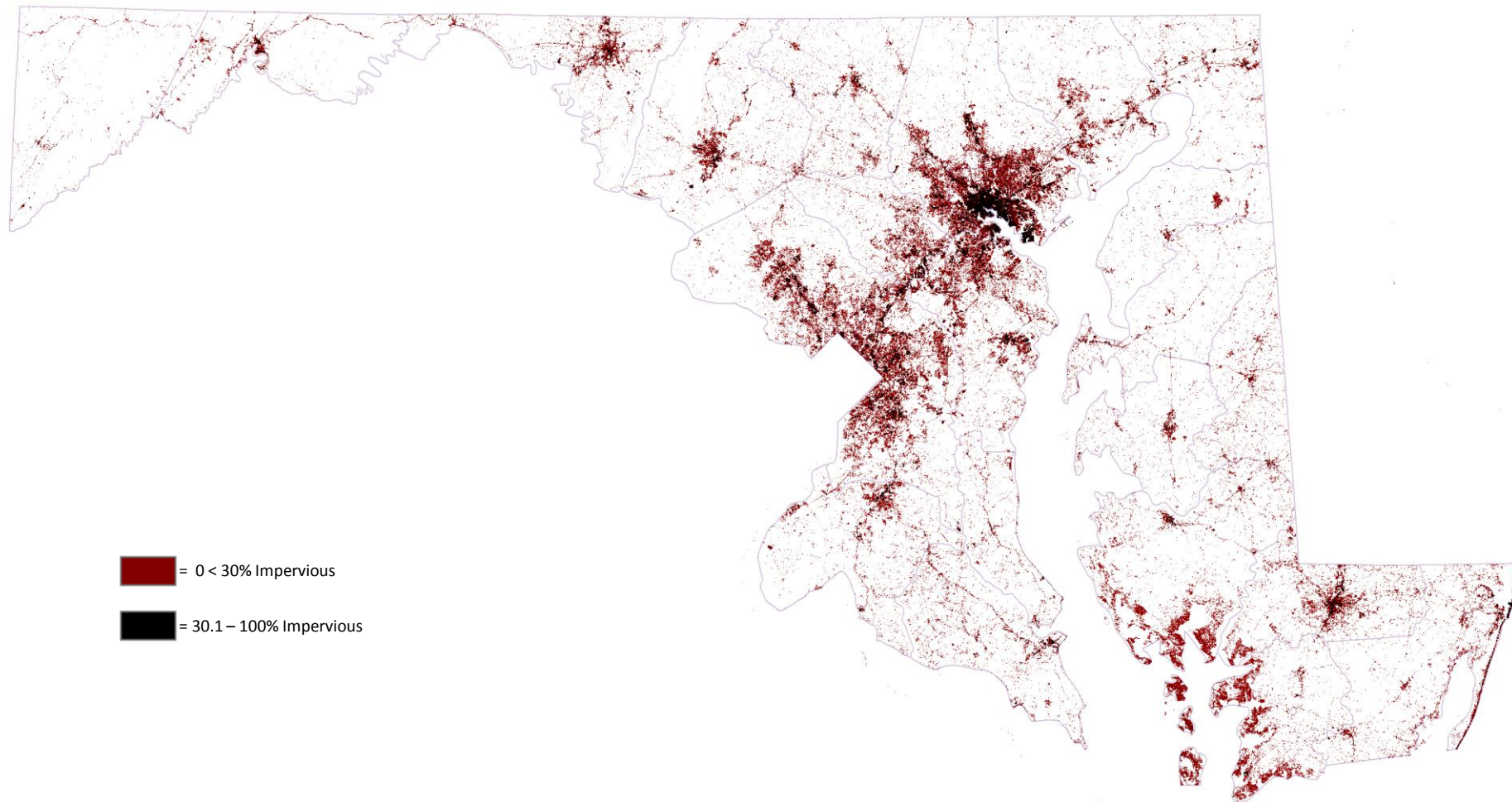
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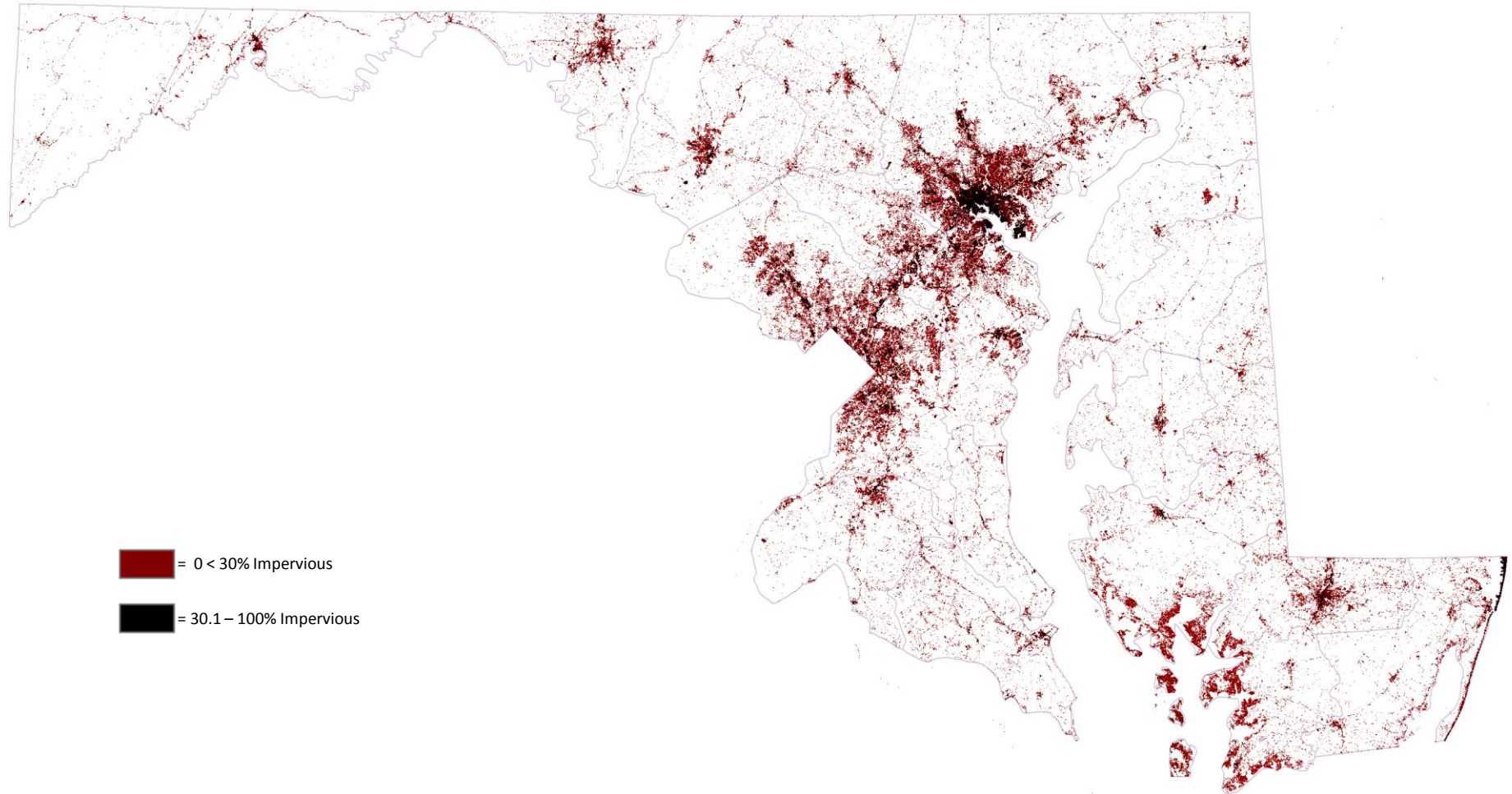
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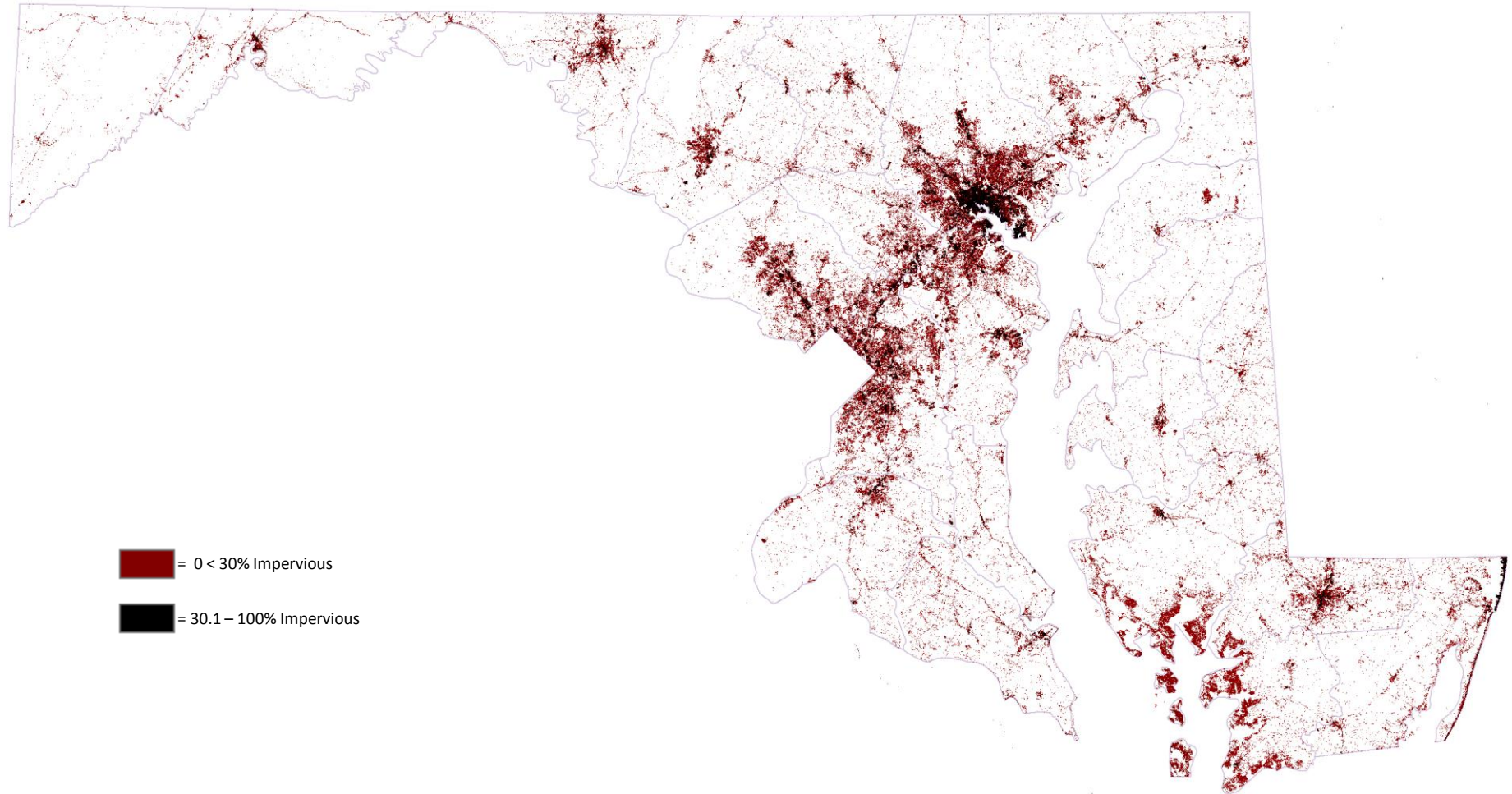
1995



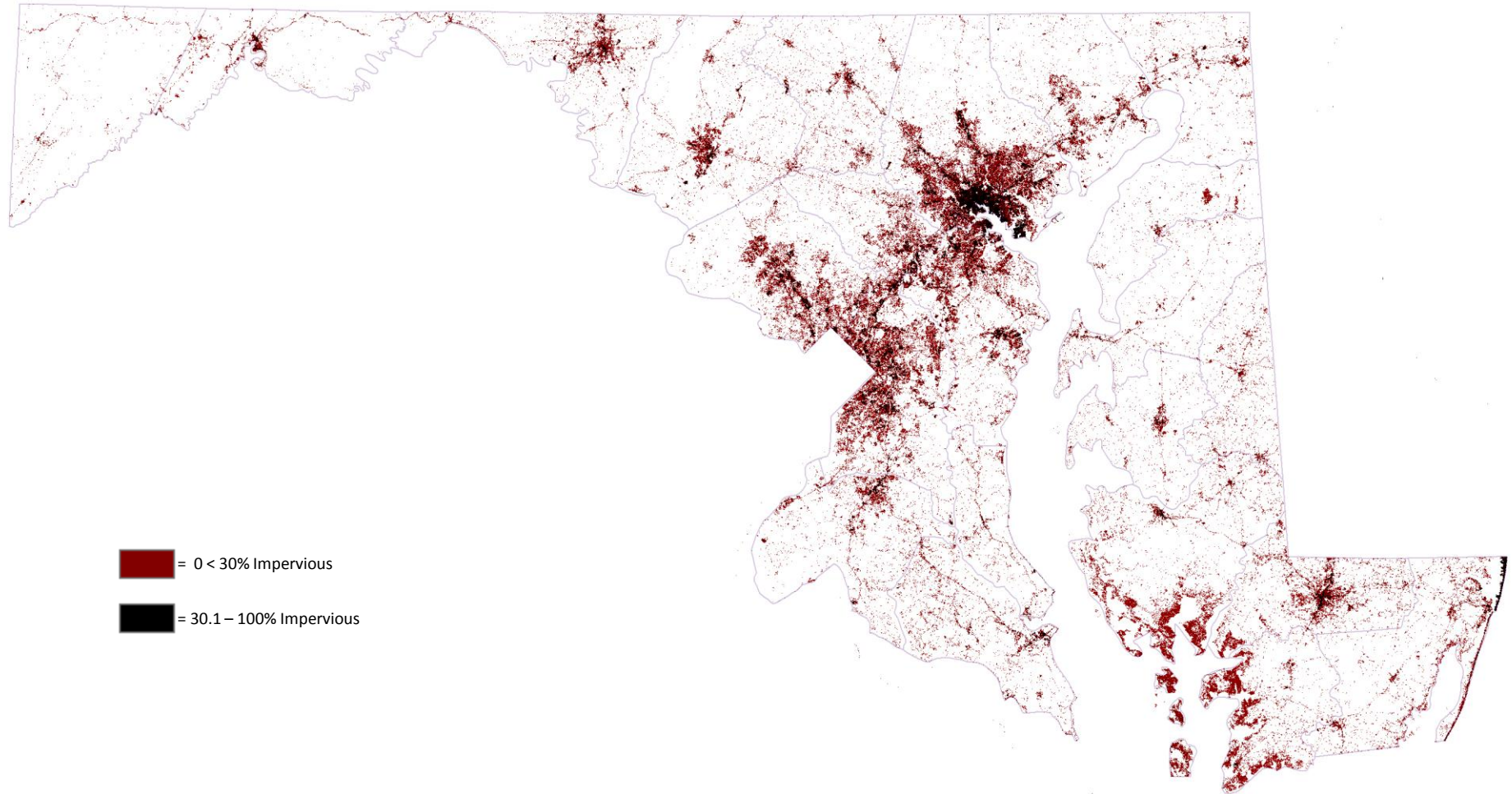
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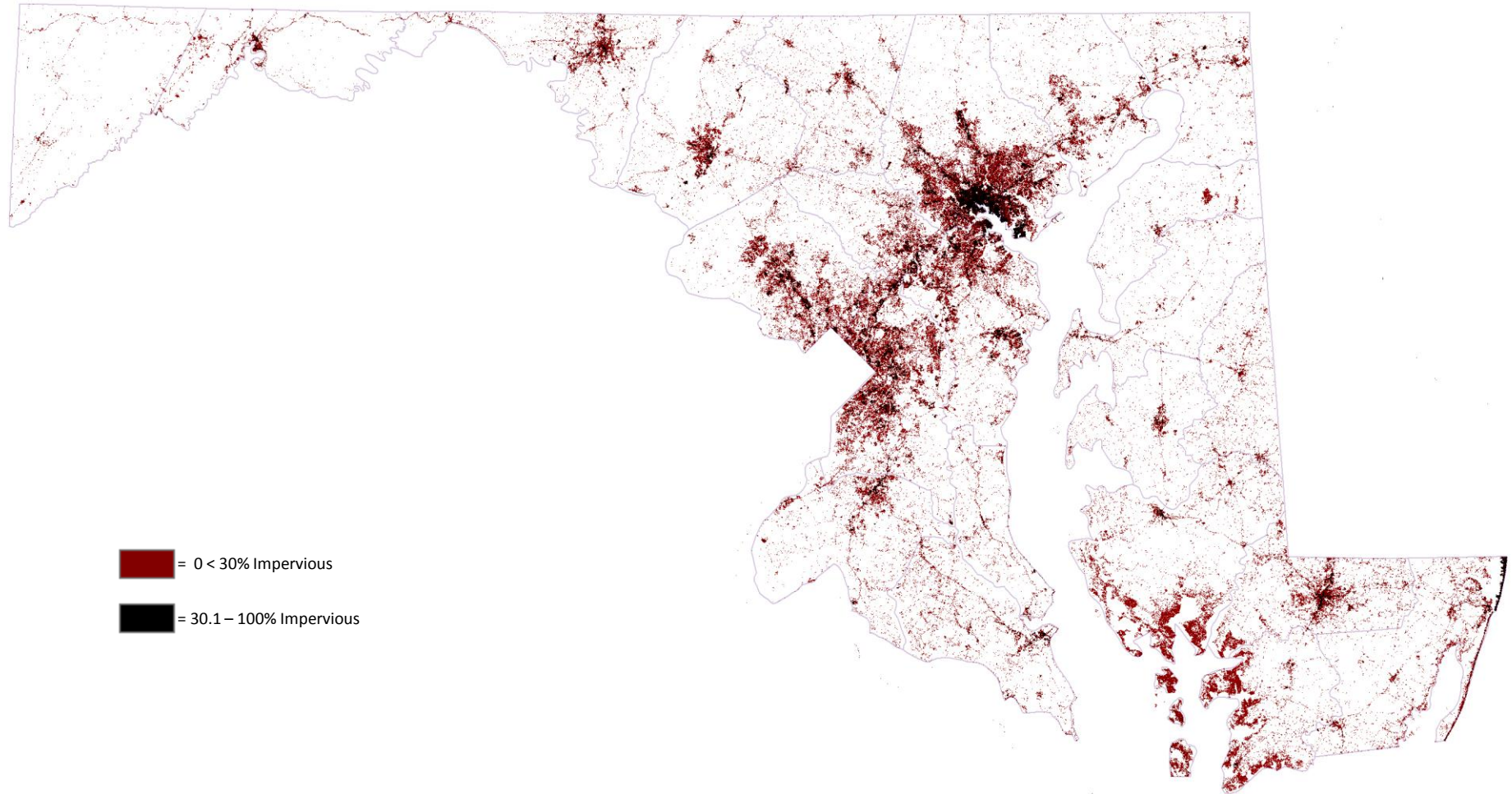
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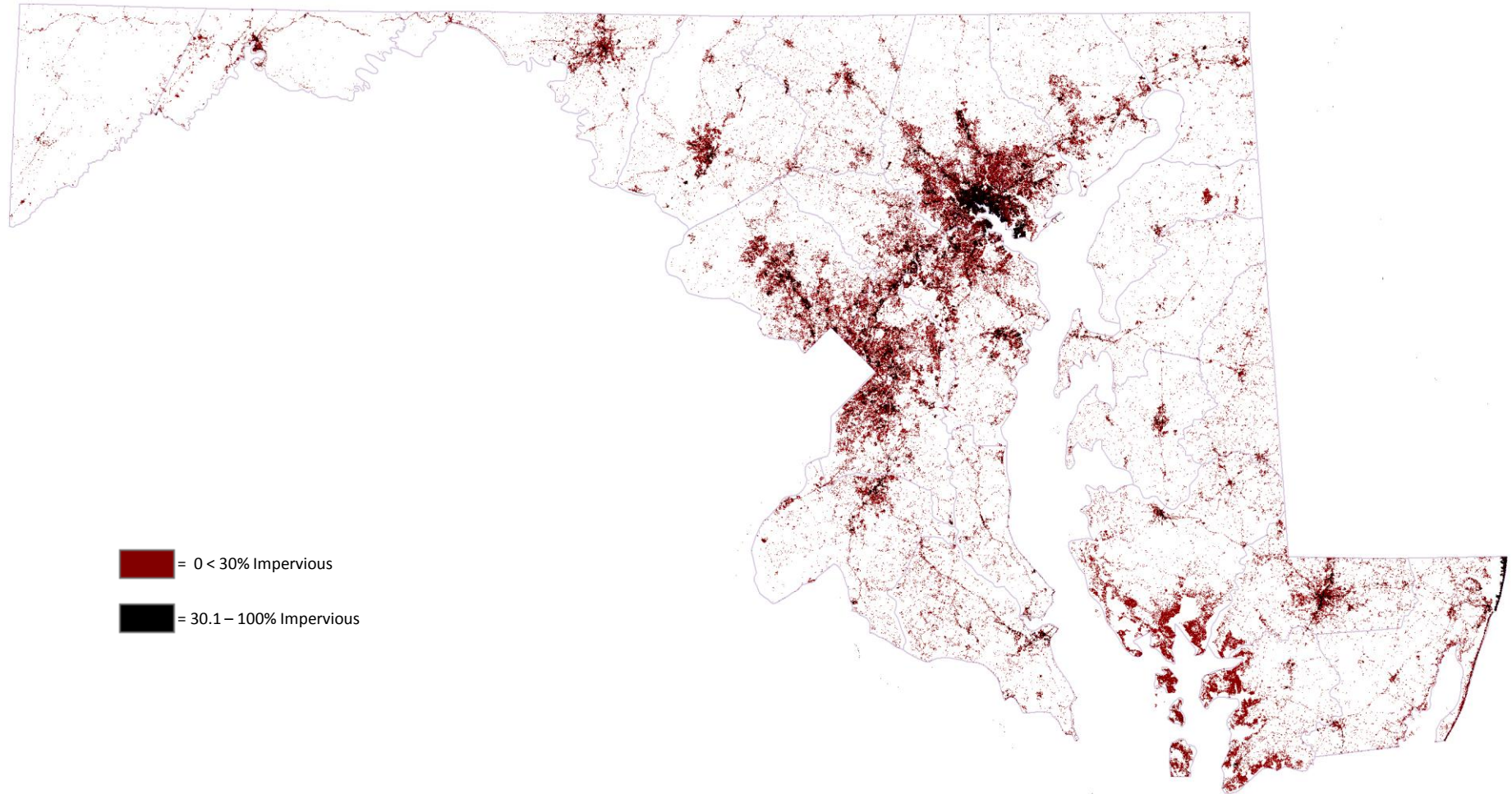
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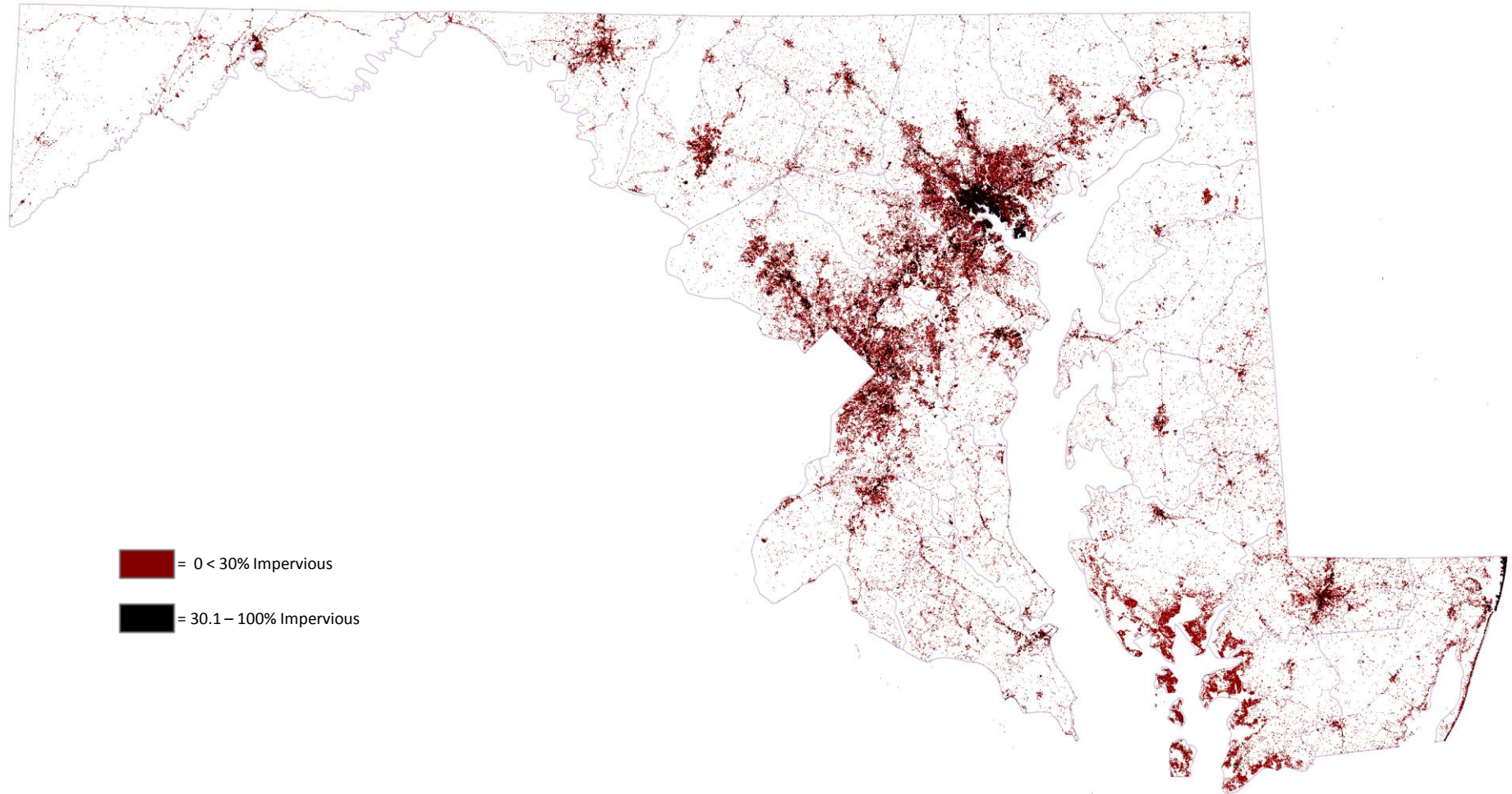
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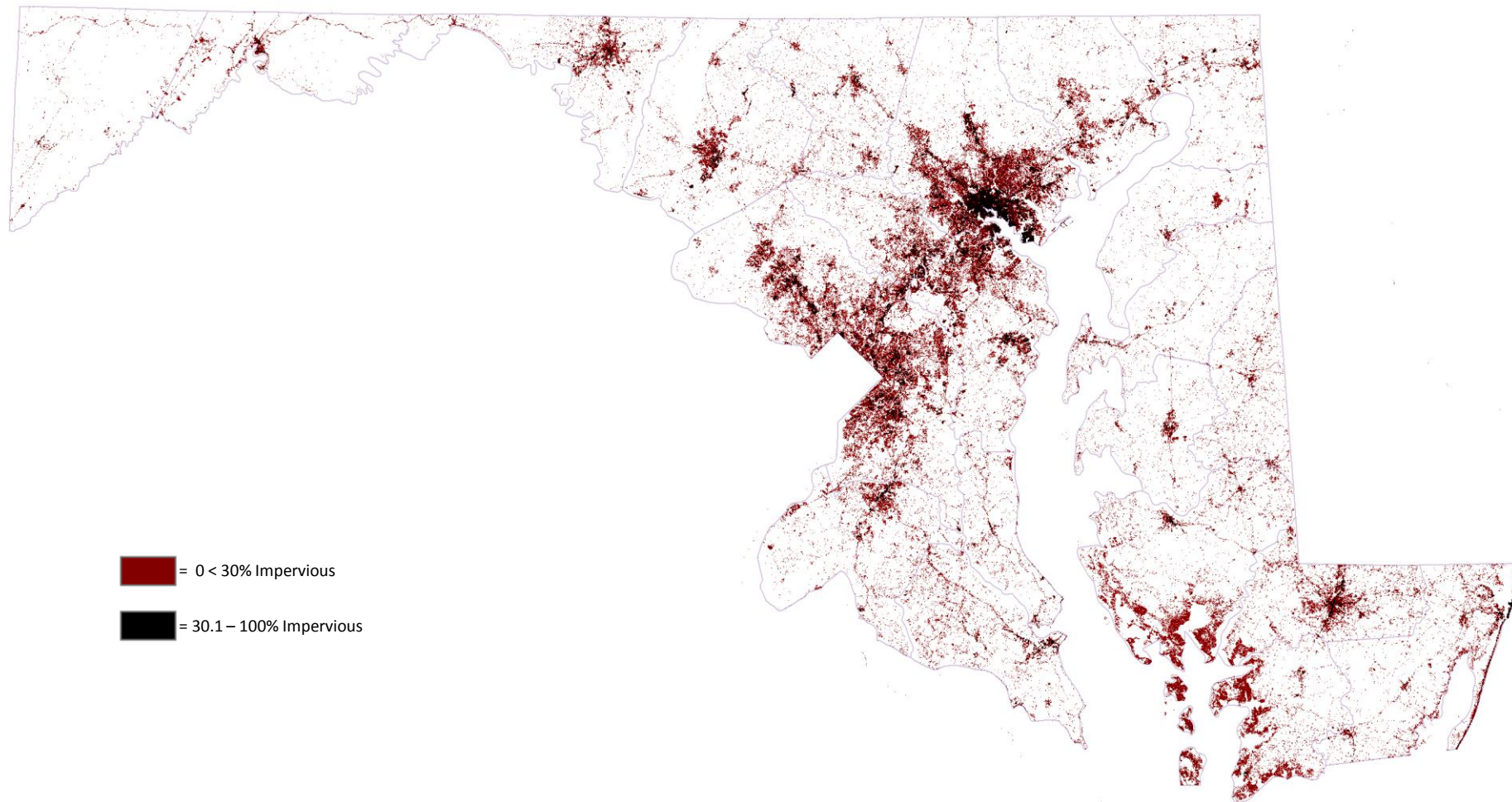
2000



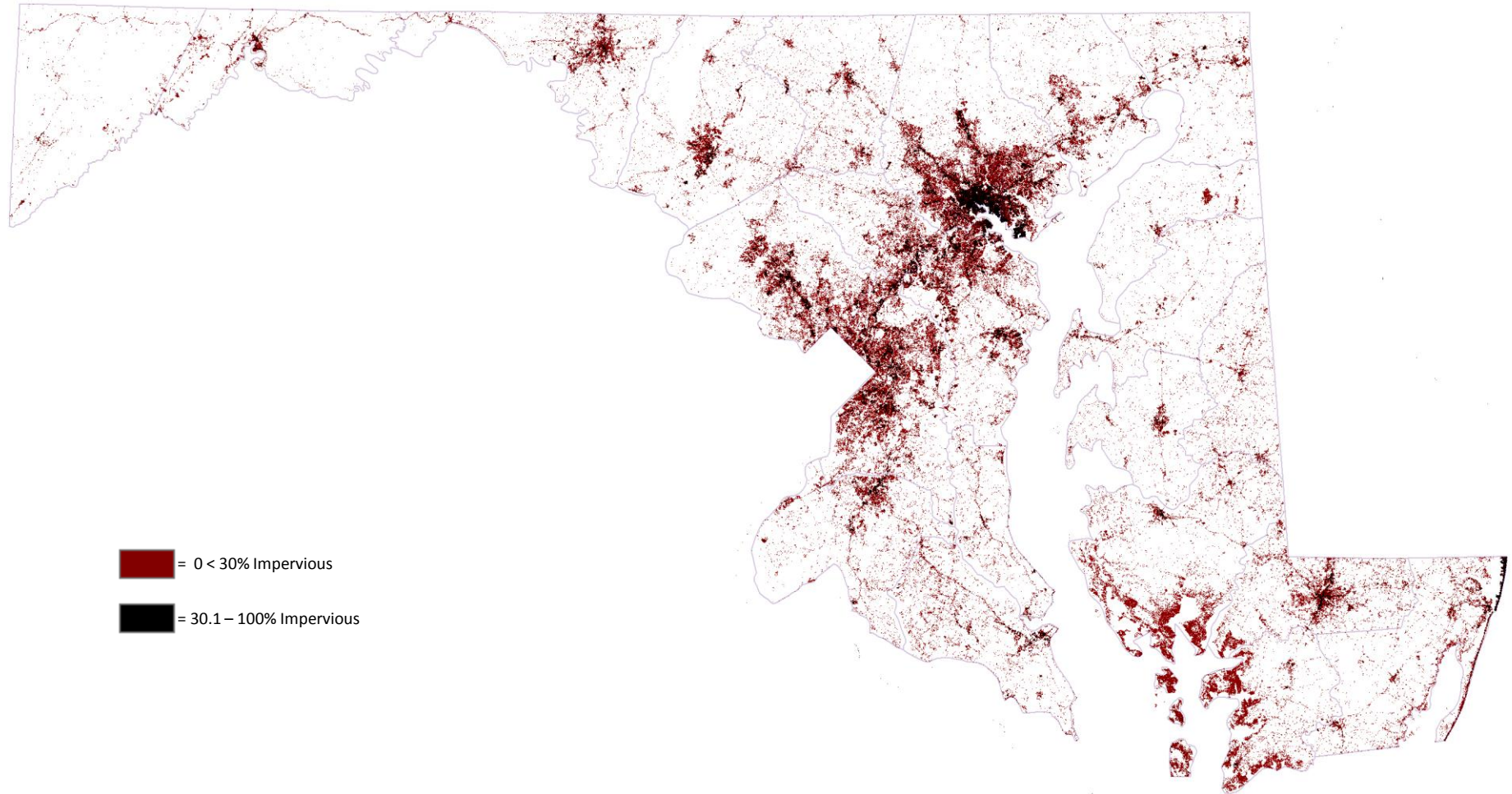
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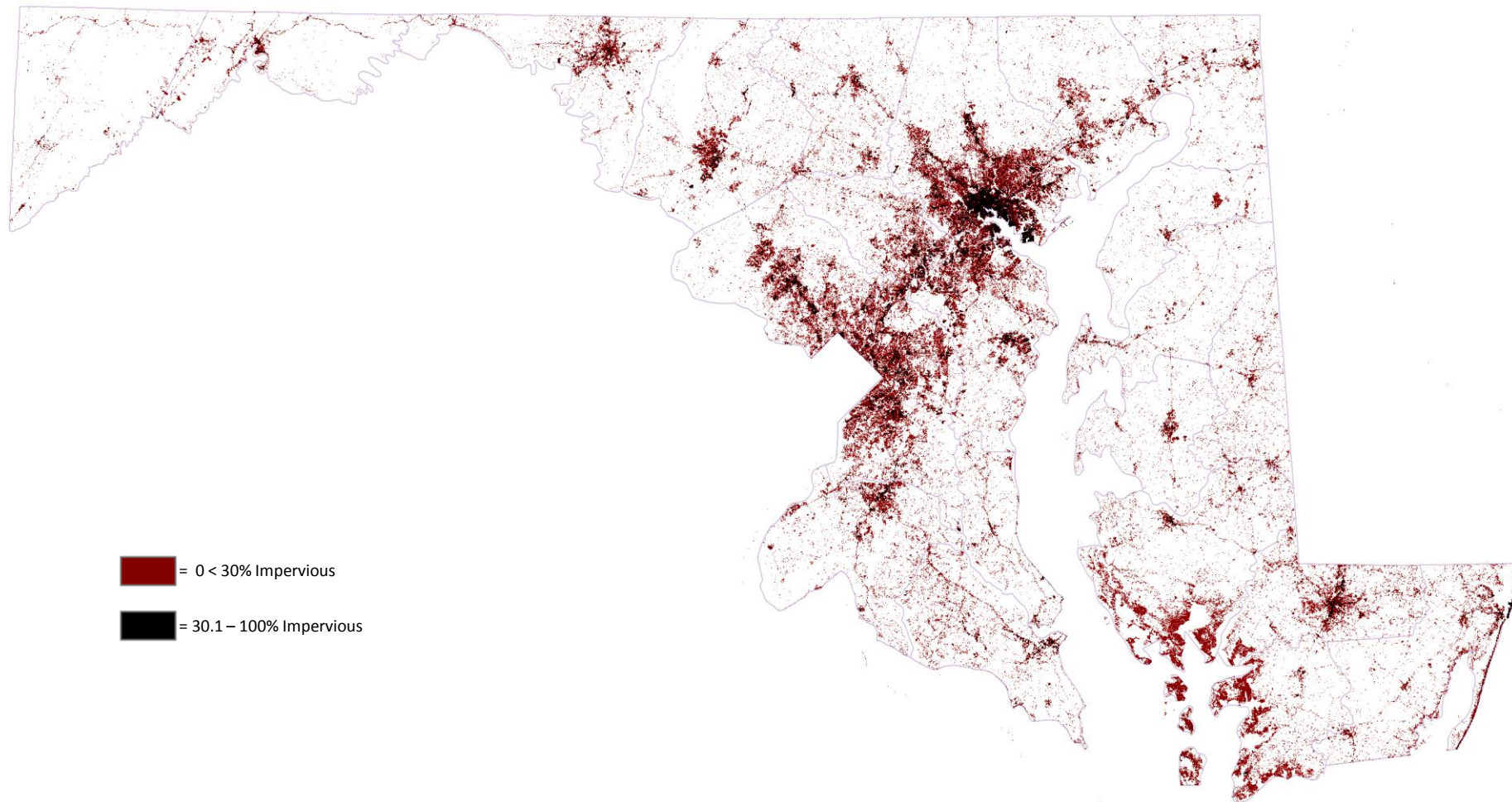
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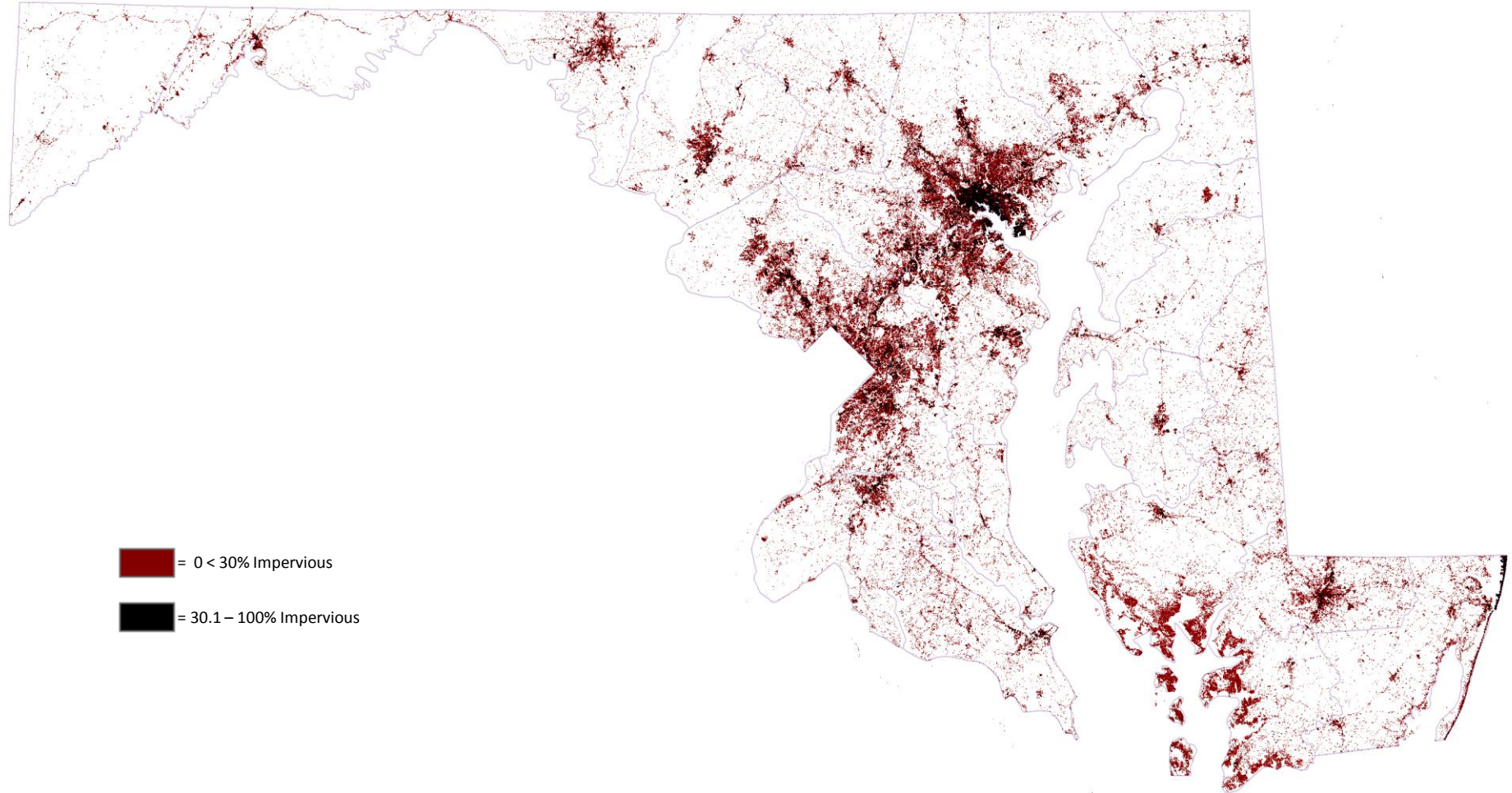
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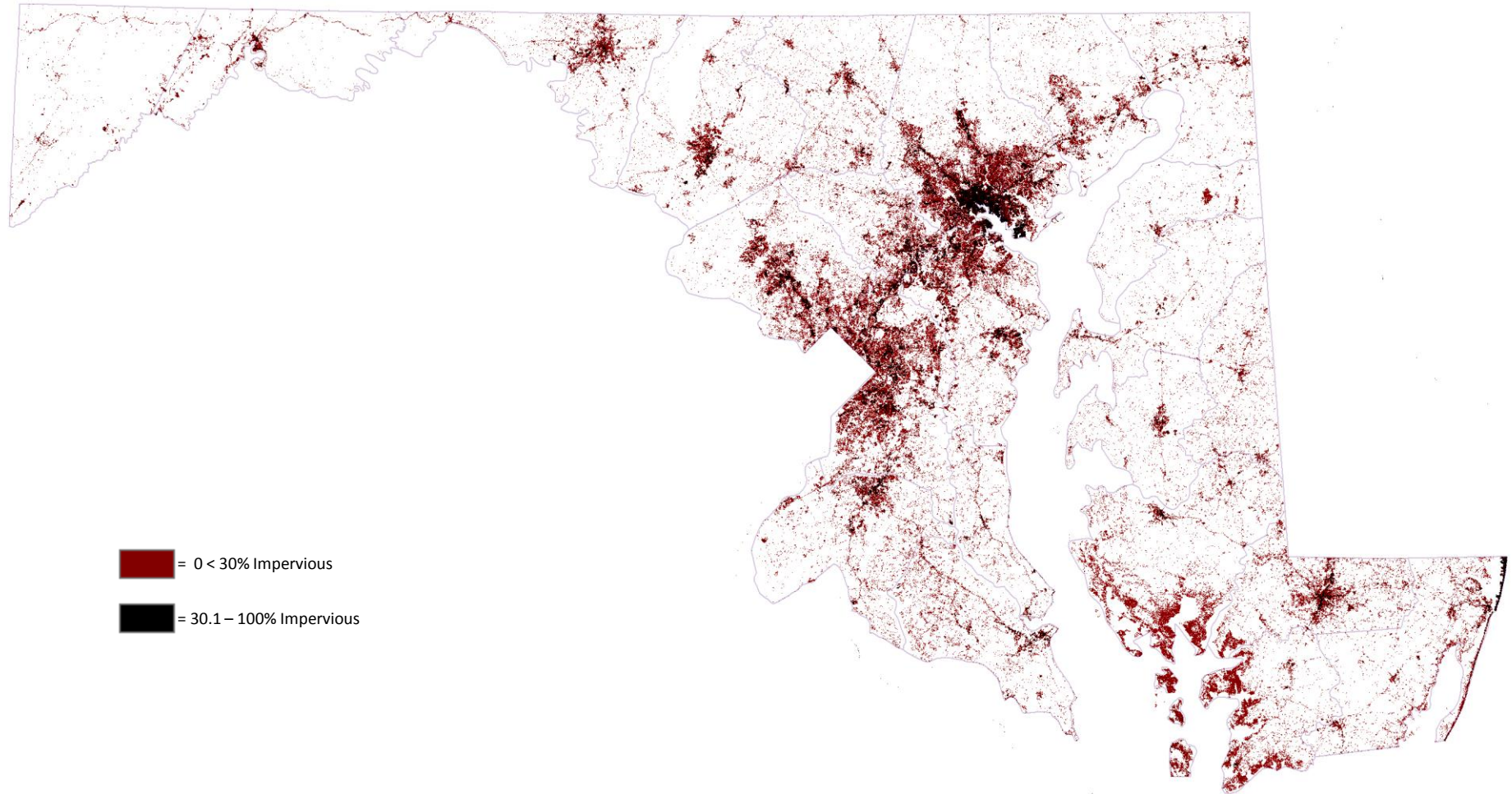
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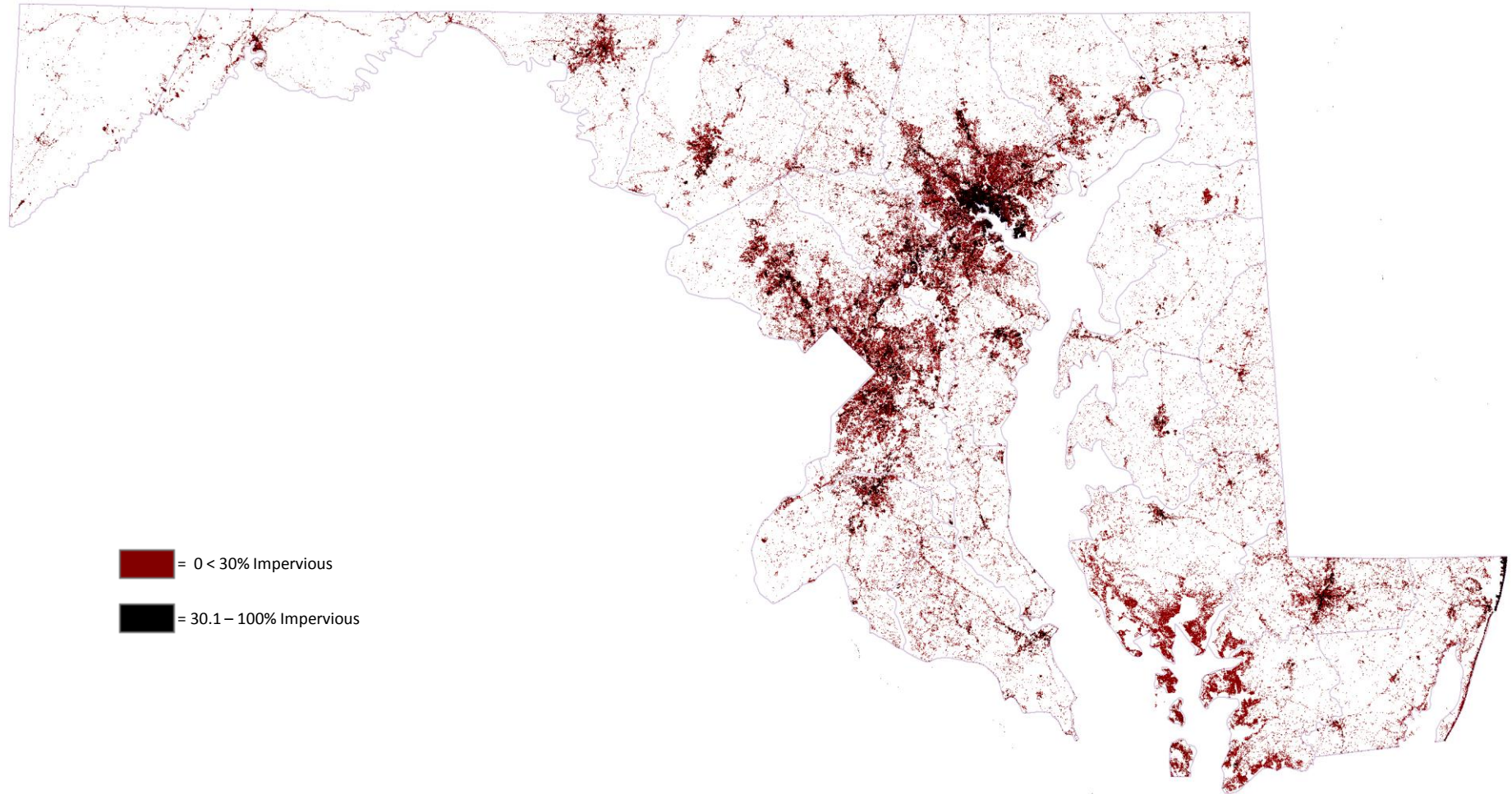
2005



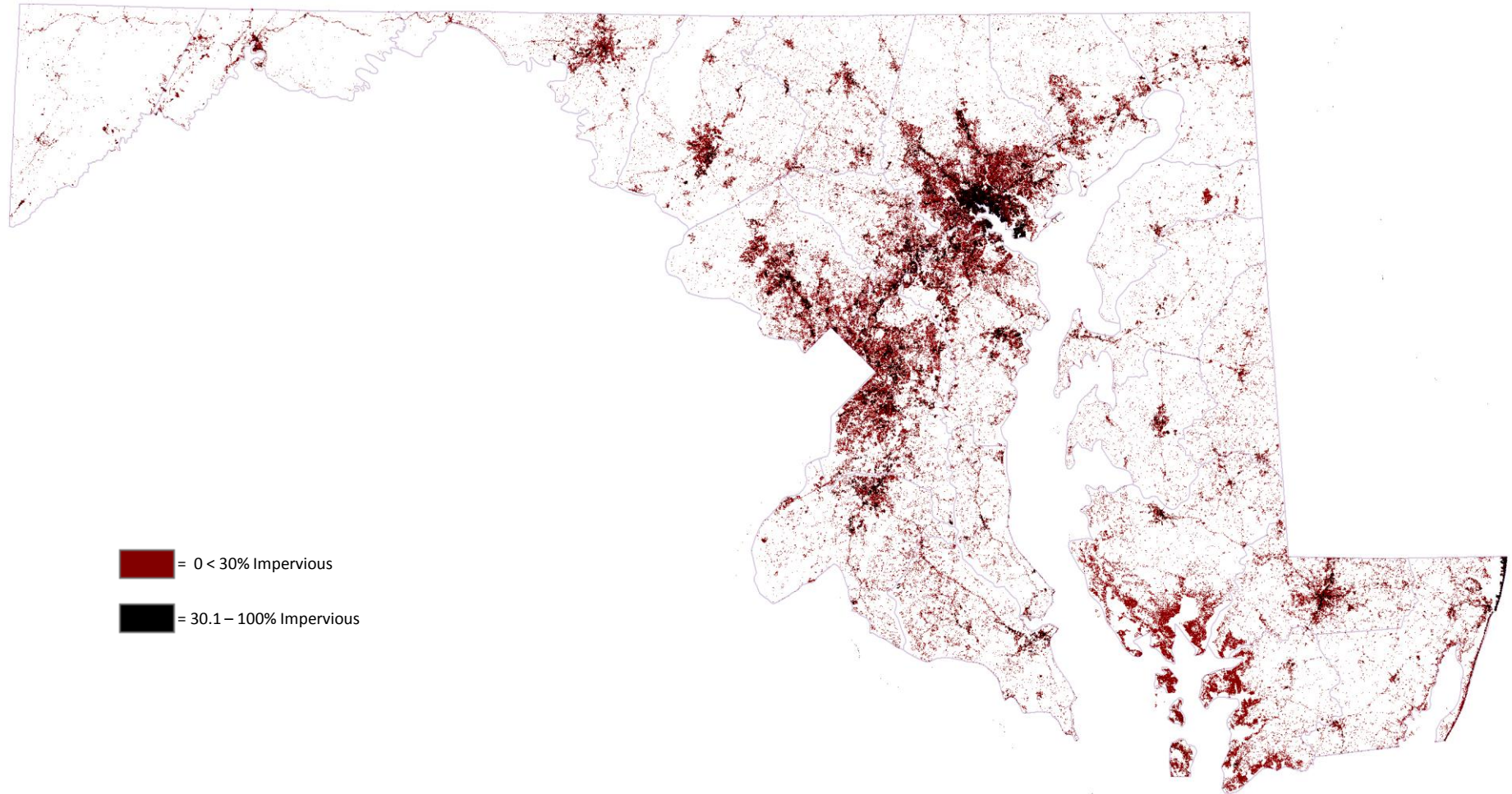
2006



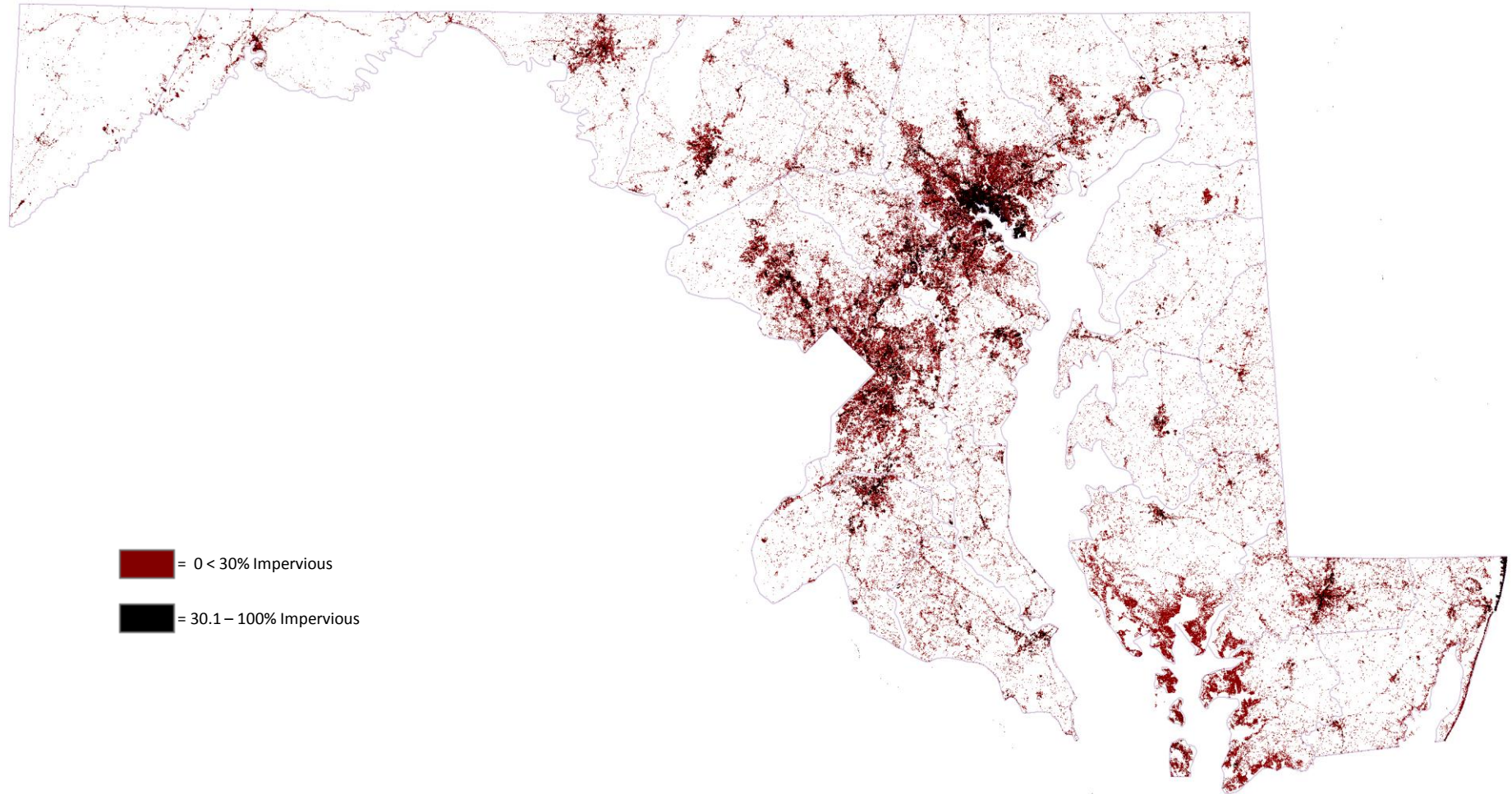
2007



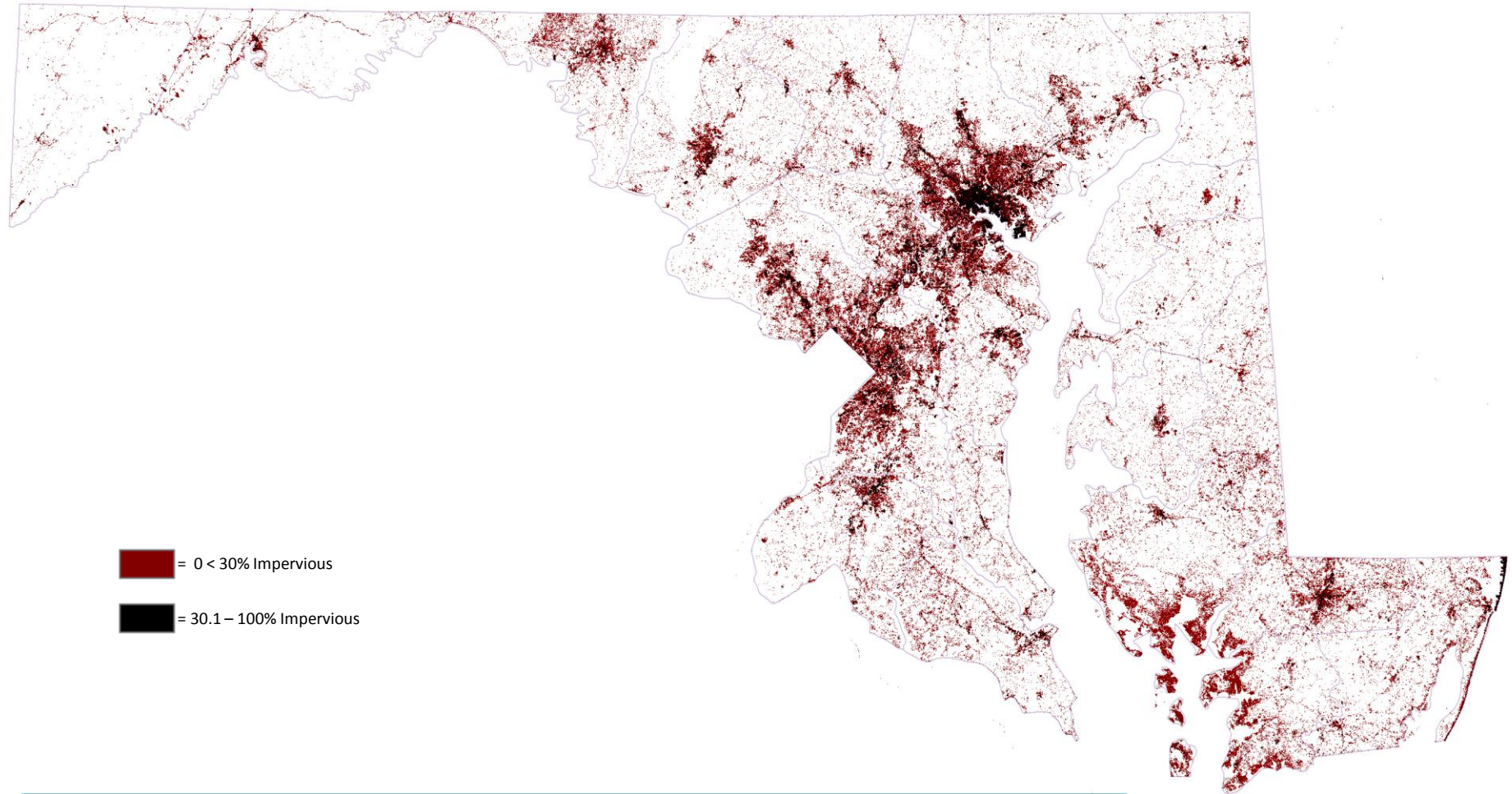
2008



2009



2010



Note from MDP: Please note that the 2010 data appears to be an anomaly compared to the other years. In particular note the rather drastic increase in imperviousness from 2009 to 2010. USGS has been contacted to address this.

Impervious Surfaces > Polygon Analyses

All *residential* land uses (Coded 11, 12, 13, or 191/192) have been intersected with USGS's imagery (after polygon transformation).

Therefore we can view the impervious percent of all residential LULC polygons. As we will see, some of the polygons for which the MDP LULC data depict as low, medium, and even high residential areas have zero impervious value per USGS.

2000 Statistics

(based on 2002 MDP LULC data, 2000 Imagery)

MDP Land Use	The Average Imperviousness of the Statewide Surface
Low Density Residential	5.0%
Medium Density Residential	9.2%
High Density Residential	19.6%

County	Average Imperviousness of All Residential Land Uses	Average Imperviousness of the County's Low Density Residential	Average Imperviousness of the County's Medium Density Residential	Average Imperviousness of the County's High Density Residential
Allegany	7.2%	3%	8%	8%
Anne Arundel	10.5%	5%	10%	16%
Baltimore City	26.2%	6%	13%	33%
Baltimore County	12.5%	8%	11%	17%
Calvert	5.0%	3%	8%	11%
Caroline	5.9%	4%	9%	12%
Carroll	6.2%	4%	7%	12%
Cecil	5.4%	4%	6%	9%
Charles	7.7%	5%	9%	15%
Dorchester	6.6%	5%	9%	14%
Frederick	6.4%	3%	7%	10%
Garrett	4.5%	4%	5%	7%
Harford	6.5%	4%	6%	9%
Howard	8.0%	5%	7%	13%
Kent	6.3%	3%	7%	11%
Montgomery	8.3%	6%	7%	15%
Prince George's	10.8%	6%	9%	16%
Queen Anne's	5.4%	4%	6%	15%
Somerset	7.0%	5%	9%	16%
St. Mary's	5.4%	4%	7%	13%
Talbot	7.3%	4%	9%	11%
Washington	6.8%	4%	8%	10%
Wicomico	8.5%	6%	11%	17%
Worcester	18.0%	6%	15%	44%

2008 Statistics

(based on 2010 MDP LULC data, 2010 Imagery)

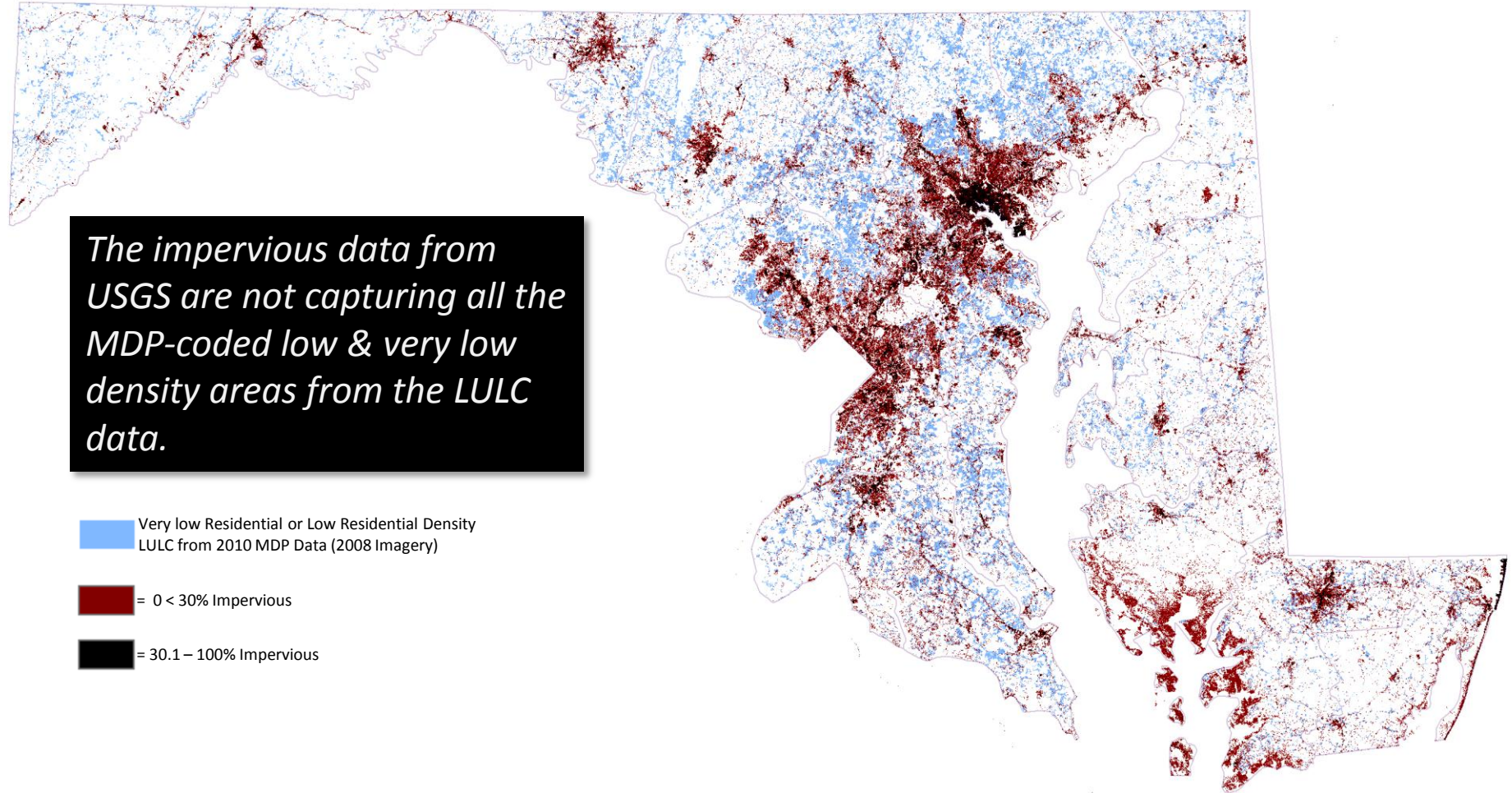
Land Use	The Average Imperviousness of the Statewide Surface
Very Low Residential, Agricultural	4.9%
Very Low Residential, Forest	4.1%
Low Density Residential	5.4%
Medium Density Residential	10.4%
High Density Residential	20.2%

County	Average Imperviousness of All Residential Land Uses	Low Density Residential	Medium Density Residential	High Density Residential	Very Low Residential - Agricultural	Very Low Residential - Forest
Allegany	6.8%	4%	6%	12%	2%	1%
Anne Arundel	11.4%	6%	11%	18%	6%	5%
Baltimore City	27.0%	7%	14%	33%	0%	0%
Baltimore County	13.4%	5%	12%	19%	4%	4%
Calvert	7.0%	5%	10%	19%	5%	5%
Caroline	5.8%	4%	10%	12%	5%	3%
Carroll	6.1%	4%	8%	13%	3%	3%
Cecil	4.8%	3%	6%	9%	3%	2%
Charles	10.8%	7%	15%	20%	6%	4%
Dorchester	6.9%	5%	10%	16%	5%	4%
Frederick	6.4%	3%	6%	12%	3%	2%
Garrett	3.9%	3%	5%	7%	2%	1%
Harford	6.9%	4%	7%	10%	2%	2%
Howard	9.6%	6%	9%	17%	5%	4%
Kent	5.8%	3%	7%	13%	4%	1%
Montgomery	9.2%	5%	7%	15%	5%	4%
Prince George's	12.6%	8%	11%	19%	7%	6%
Queen Anne's	5.7%	4%	8%	13%	3%	2%
Somerset	7.0%	5%	9%	16%	6%	5%
St. Mary's	7.0%	6%	10%	18%	5%	5%
Talbot	7.6%	4%	11%	13%	3%	3%
Washington	6.9%	4%	7%	14%	3%	2%
Wicomico	9.0%	6%	12%	20%	6%	5%
Worcester	16.0%	7%	16%	44%	6%	4%

Select Views

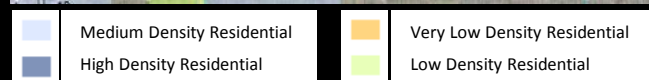
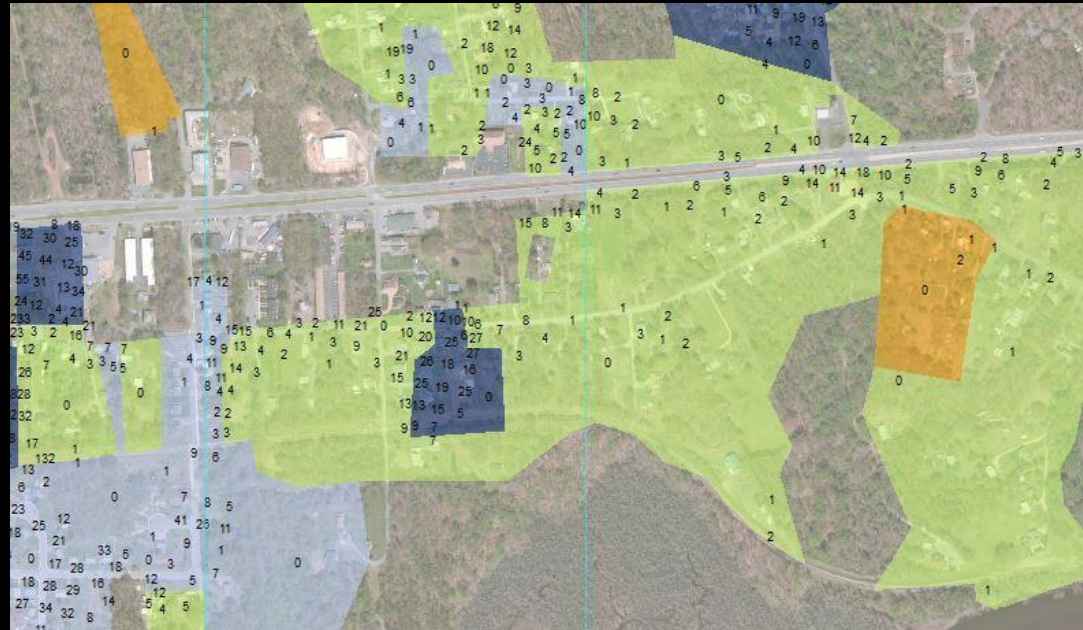
The following map and subsequent screenshots display the interactions between MDP's Land Use Cover (LULC) data and USGS's Impervious Data.

2008 Low Density Residential & Imperviousness



Select Views (Charles County):

Charles County serves as an example where there may be some potential issues b/n MDP's LULC and USGS data. As the picture shows, there are several areas that are very low density residential (orange color) AND low density residential (green color) and even some high density residential (dark blue color), that have 0% *imperviousness*. A concern moving forward is that these areas (often in the very low and low density residential areas) are represented as completely pervious when, in fact, there are houses on these properties. For Charles county, the aggregate numbers shown in the table below appear to average out (albeit the overall imperviousness is a bit higher than other southern counties) but this is something for which MDP should be mindful.



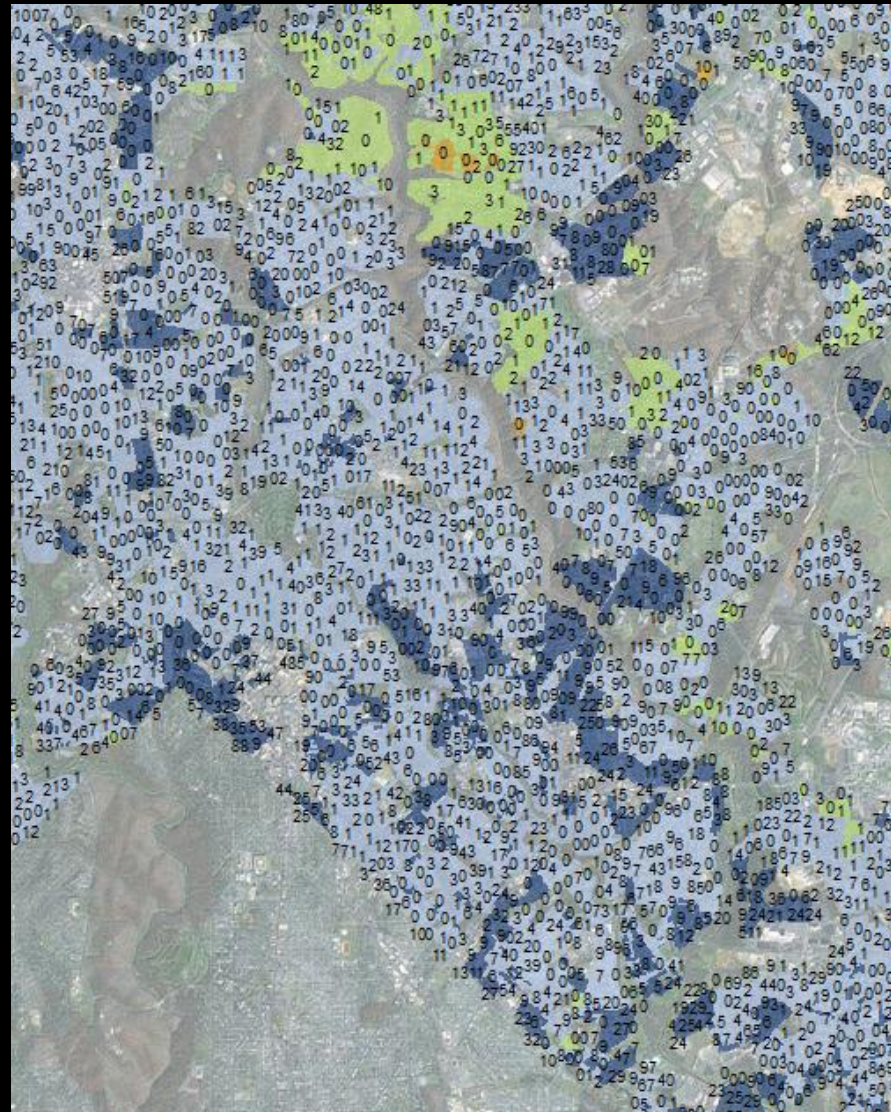
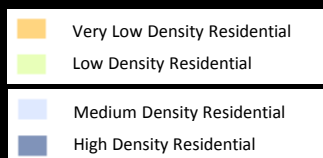
Charles County

County	Average Imperviousness of All Residential Land Uses	Low Density Residential	Medium Density Residential	High Density Residential	Very Low Residential - Agricultural	Very Low Residential - Forest
Allegany	6.8%	4%	6%	12%	2%	1%
Anne Arundel	11.4%	6%	11%	18%	6%	5%
Baltimore City	27.0%	7%	14%	33%	0%	0%
Baltimore County	13.4%	5%	12%	19%	4%	4%
Calvert	7.0%	5%	10%	19%	5%	5%
Caroline	5.8%	4%	10%	12%	5%	3%
Carroll	6.1%	4%	8%	13%	3%	3%
Cecil	4.8%	3%	6%	9%	3%	2%
Charles	10.8%	7%	15%	20%	6%	4%

Select Views (Washington DC Beltway Vicinity | Montgomery & Prince George's Counties):

The residential developments abounding in Maryland to the northeast of the US Capitol and straddling the I-495 beltway are unsurprisingly primarily notated as medium-density residential.

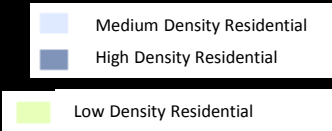
However, it is important to notice that within these large swaths of medium-density developments, the USGS impervious data are often coded as 0% impervious.



Residential Development Northeast of Washington, D.C.

Select Views (Inner Harbor | Baltimore City):

This screenshot of the Inner Harbor and the surrounding areas in Baltimore City depicts a highly dense urban area with both high density residential land uses as well as swaths of non-residential areas. Although this example appears to accurately correlate MDP’s LULC data of high-density and medium-density residential areas with USGS’s impervious data, it is worth noting that there are scattered sections of medium-density residential LULC polygons that are coded as having 0% imperviousness in the USGS data.



The Inner Harbor and Vicinity, Baltimore City

County	Average Imperviousness of All Residential Land Uses	Low Density Residential	Medium Density Residential	High Density Residential	Very Low Residential - Agricultural	Very Low Residential - Forest
Baltimore City	27.0%	7%	14%	33%	0%	0%

Select Views (Ocean City | Worcester County):

One thing that is quickly apparent is the relative high average imperviousness found within the High Density Residential areas of Worcester County. While at first this may appear an errant outlier, upon closer inspection it can be explained by the relative dearth of sample size comprising very high imperviousness in Ocean City.

As the illustration showing a section of Ocean City indicates, the areas of high density residential (in dark blue) have relatively high percentages of imperviousness (generally 50+ as shown in the illustration). The remainder of the county has relatively few areas of high density residential and thus Ocean City becomes the main area from which Worcester County's high density residential average impervious surface derives.

County	Average Imperviousness of All Residential Land Uses	Low Density Residential	Medium Density Residential	High Density Residential
Allegany	6.8%	4%	6%	12%
Anne Arundel	11.4%	6%	11%	18%
Baltimore City	27.0%	7%	14%	33%
Baltimore County	13.4%	5%	12%	19%
Calvert	7.0%	5%	10%	19%
Caroline	5.8%	4%	10%	12%
Carroll	6.1%	4%	8%	13%
Cecil	4.8%	3%	6%	9%
Charles	10.8%	7%	15%	20%
Dorchester	6.9%	5%	10%	16%
Frederick	6.4%	3%	6%	12%
Garrett	3.9%	3%	5%	7%
Harford	6.9%	4%	7%	10%
Howard	9.6%	6%	9%	17%
Kent	5.8%	3%	7%	13%
Montgomery	9.2%	5%	7%	15%
Prince George's	12.6%	8%	11%	19%
Queen Anne's	5.7%	4%	8%	13%
Somerset	7.0%	5%	9%	16%
St. Mary's	7.0%	6%	10%	18%
Talbot	7.6%	4%	11%	13%
Washington	6.9%	4%	7%	14%
Wicomico	9.0%	6%	12%	20%
Worcester	16.0%	7%	16%	44%

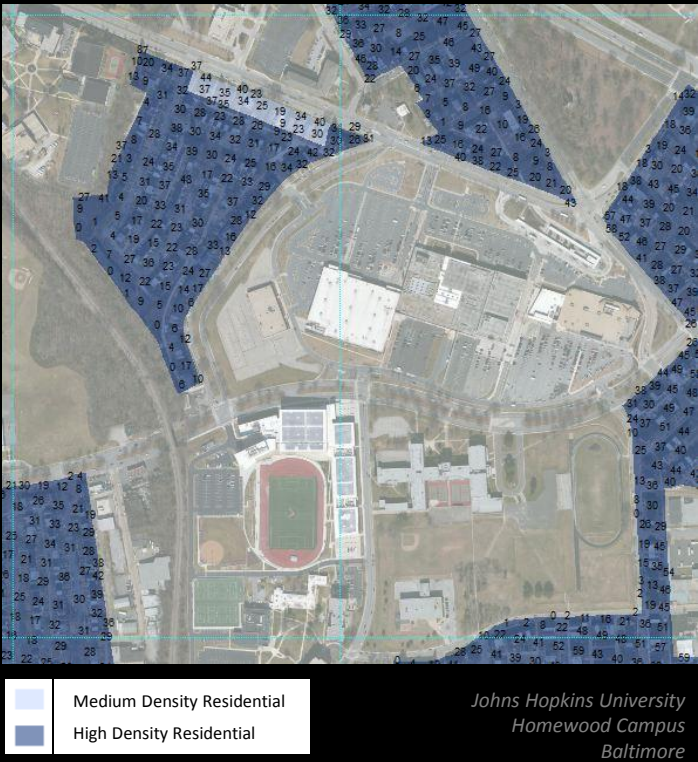


Select Views (Johns Hopkins University | Baltimore City):

As expected, Baltimore City has the highest level for an average imperviousness of *all* residential land uses (27%). What is worth noting with Baltimore City's data set is that it does appear to accurately isolate the residential lands and attribute perviousness in high density areas in which such things as row house yards or setbacks decrease imperviousness.

In this picture, notice how the facilities of Johns Hopkins University are correctly excluded while the neighboring high density residential developments have degrees of imperviousness generally ranging from 20-40.

County	Average Imperviousness of All Residential Land Uses	Low Density Residential	Medium Density Residential	High Density Residential
Allegany	6.8%	4%	6%	12%
Anne Arundel	11.4%	6%	11%	18%
Baltimore City	27.0%	7%	14%	33%
Baltimore County	13.4%	5%	12%	19%
Calvert	7.0%	5%	10%	19%
Caroline	5.8%	4%	10%	12%
Carroll	6.1%	4%	8%	13%
Cecil	4.8%	3%	6%	9%
Charles	10.8%	7%	15%	20%
Dorchester	6.9%	5%	10%	16%
Frederick	6.4%	3%	6%	12%
Garrett	3.9%	3%	5%	7%
Harford	6.9%	4%	7%	10%
Howard	9.6%	6%	9%	17%
Kent	5.8%	3%	7%	13%
Montgomery	9.2%	5%	7%	15%
Prince George's	12.6%	8%	11%	19%
Queen Anne's	5.7%	4%	8%	13%
Somerset	7.0%	5%	9%	16%
St. Mary's	7.0%	6%	10%	18%
Talbot	7.6%	4%	11%	13%
Washington	6.9%	4%	7%	14%
Wicomico	9.0%	6%	12%	20%
Worcester	16.0%	7%	16%	44%



Select Views (Western | Garrett County):

This screenshot of Deep Creek Lake in Garrett County serves as an example of an area that contains pockets of residential development amid larger areas of non-residential land uses. As the picture shows, there are several areas that are very low density residential (orange color), low density residential (green color), and even some medium density residential (light blue color), that have 0% imperviousness. However, for the most part, the imperviousness data in this section accurately reflect MDP’s LULC data.



Deep Creek Lake, Garrett County

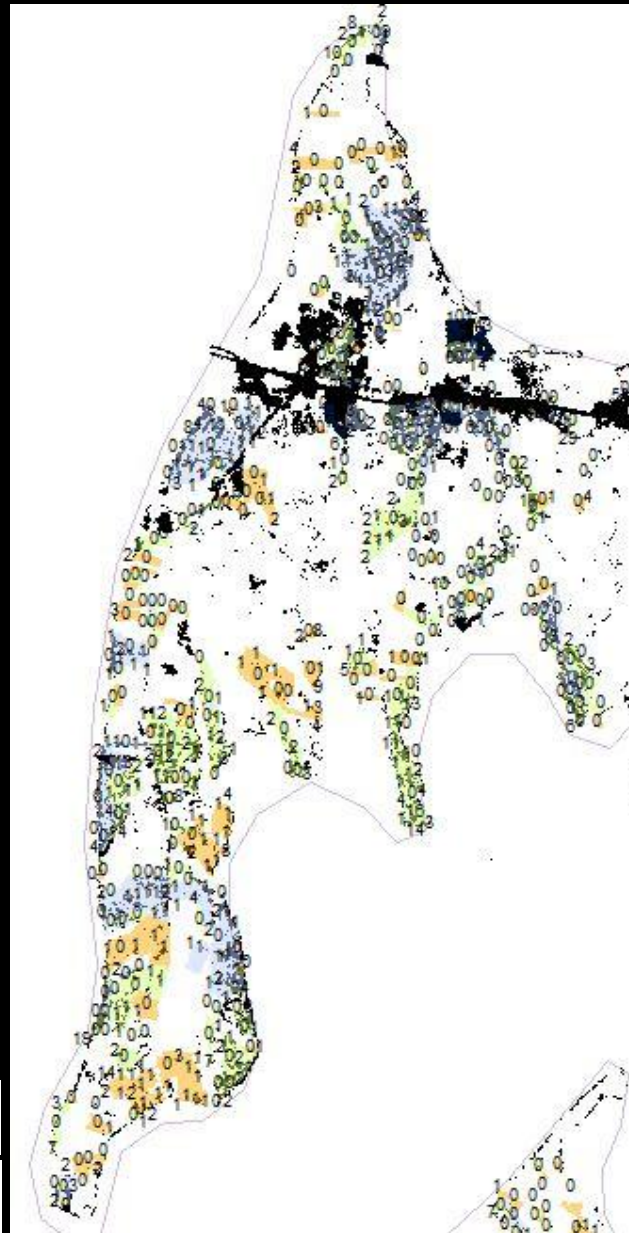
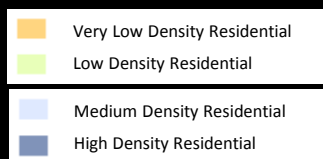


County	Average Imperviousness of All Residential Land Uses	Low Density Residential	Medium Density Residential	High Density Residential	Very Low Residential - Agricultural	Very Low Residential - Forest
Garrett	3.9%	3%	5%	7%	2%	1%

Select Views (Chesapeake Bay Coastal | Queen Anne's County):

This screenshot of Kent Island in Queen Anne's County where US-50 crosses from Anne Arundel County into Queen Anne's County depicts development in a Bay-coastal Maryland County. As the picture shows, there are several areas that are very low density residential (orange color), low density residential (green color), and medium density residential (light blue color) that have 0% imperviousness.

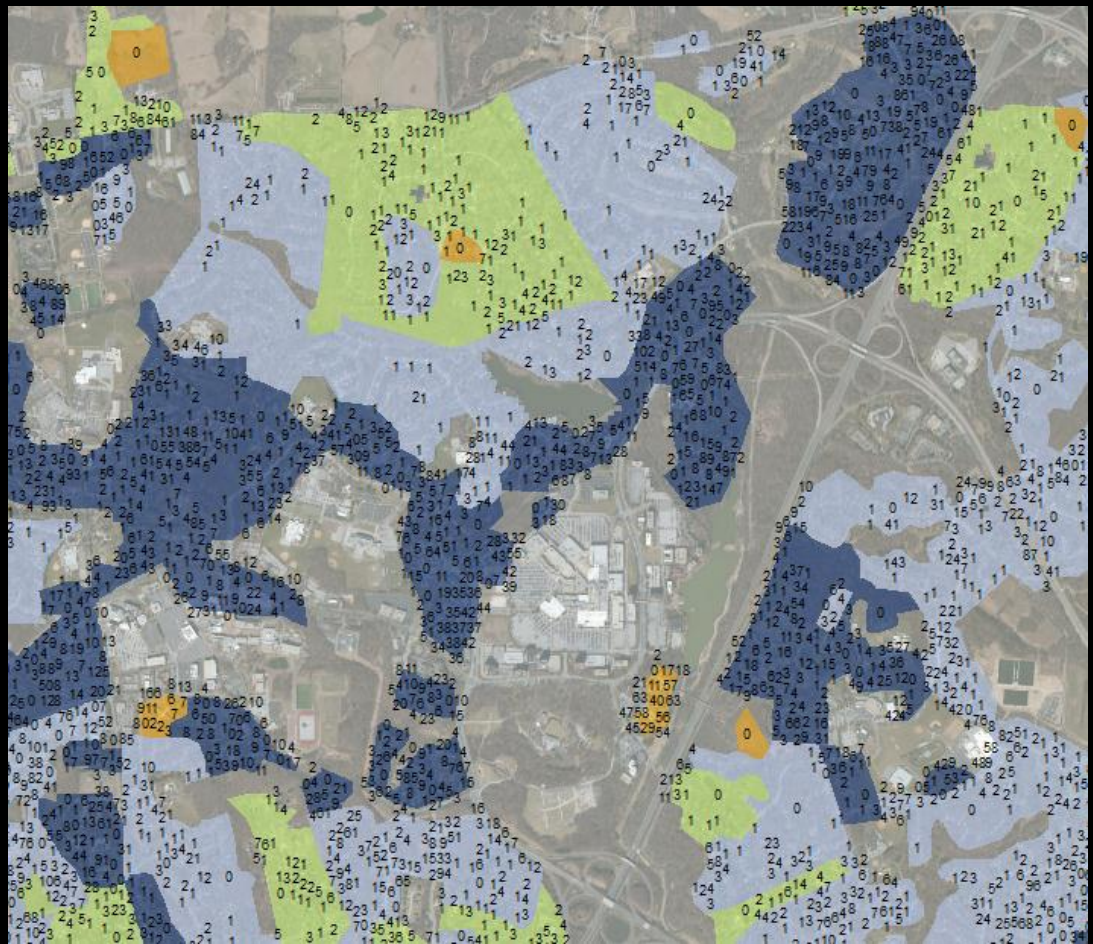
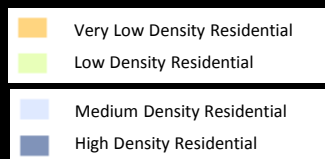
As the illustration on the left shows (wherein black areas depict *any* level of imperviousness), most of the island is pervious. The residential LULC data depict areas of very low, low, and medium density residential within those same USGS areas of 0% imperviousness.



Source: Esri, Imagery, USDA, US
User Community

Select Views (Columbia | Howard County):

Columbia, Maryland provides a good example of a mix of residential densities per MDP's LULC data. (This screenshot depicts Columbia's Town Center and vicinity). As we have seen throughout Maryland, the MDP LULC residential data that are coded very low density, low density, medium density, and even high density have shown propensities for corollary 0% impervious 'ratings' within the USGS data.



Columbia, MD (Town Center & Vicinity)

What Now:

- Regarding MD iMap, we now have 3 files:
 1. The original Raster files (1 each > 1985 – 2010: ~2 MB each)
 2. The Feature Polygons (1 each > 1985 – 2010: ~500 MB each)
 3. The Feature Polygons intersected with MDP's LULC data (2: 2000 & 2008: ~220-290 MB each)

Push to iMap as a service?:

- Interest? (andrew.bernish@maryland.gov) or (jim.cannistra@maryland.gov)
- Perhaps just Raster files & Feature Polygons for 'bookend' years only...

What Now (at MDP):

- MDP will determine the extent to which this data can be applied and/or useful both for MDP internally as well as to the larger state purview.
- MDP will meet internally with our environmental staff as well as our Land Use Analysis team to help determine if the previously-derived coefficients of imperviousness are still applicable.
 - MDP has previously worked with MDE to determine coefficients of imperviousness based on land use (E.g., Low Density Residential is assigned a percent impervious of 6%). Do the previously-generated coefficients align with the aerial imagery analysis provided by USGS?
- Further follow-up and clarification with USGS.